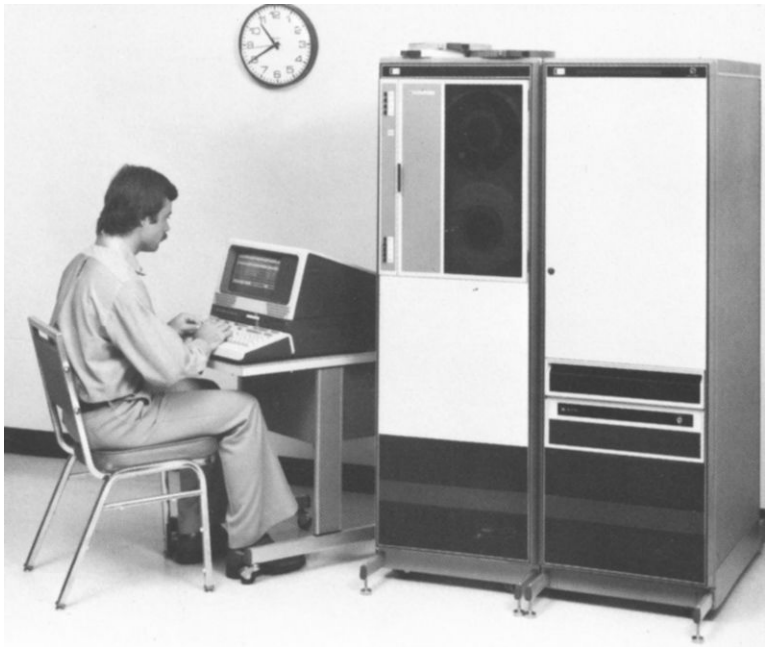
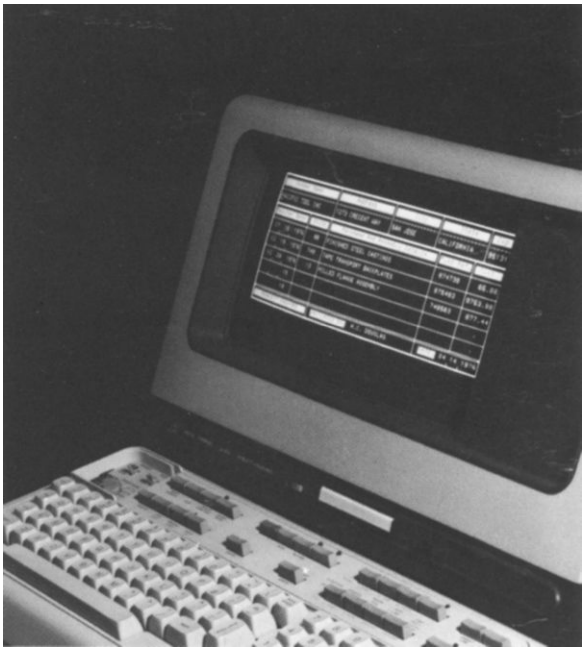
HEWLETT PACKARD

Decimal String Arithmetic Routines





Decimal String Arithmetic Routines

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PUBLICATION NOTICE

Changes in text to document software updates subsequent to the initial release are supplied in manual change notices and/or complete revisions to the manual. The history of any changes to this edition of the manual is given below under "Publication History." The last change itemized reflects the software currently documented in the manual.

Any changed pages supplied in an update package are identified by a change number adjacent to the page number. Changed information is specifically identified by a vertical line (change bar) on the outer margin of the page.

PUBLICATION HISTORY

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Preface

This manual describes the Hewlett-Packard Decimal String Arithmetic Routines. These routines perform decimal arithmetic, output editing, and code conversions which facilitate programming in HP FORTRAN, FORTRAN IV, and HP Assembler. The decimal arithmetic and output editing routines are also callable from BASIC.

This manual consists of:

- Section I is an introduction to the routines
- Section II describes the string utility routines
- Section III describes the string arithmetic routines
- Section IV describes the output editing routine, SEDIT
- Section V describes the internal string routines
- Appendix A defines the HP Character Set
- Appendix B describes the BASIC callable routines

These routines are stored in a program library. Normally, the programmer codes calls to the routines in his FORTRAN, BASIC, or Assembler source program. When compiled or assembled, the object program can be run under control of the following:

- Real-Time Executive II Software System
- Real-Time Executive III Software System

Please refer to the following manuals for information about HP languages and operating systems:

- HP Assembler Programmer's Reference Manual (02116-9014)
- HP FORTRAN Programmer's Reference Manual (02116-9015)

- FORTRAN IV Reference Manual (5951-1321)
- Real-Time Executive II Software System Programming and Operating Manual (92001-93001)
- Real-Time Executive III Software System Programming and Operating Manual (92060-90005)
- RTE Assembler Reference Manual (92060-90004)
- Multi-User Real-Time BASIC Reference Manual (92060-90016)

Contents

TABLES

SECTION I
Introduction

The Hewlett-Packard Decimal String Arithmetic Routines is a group of subroutines which provide solutions to business applications for users of Hewlett-Packard FORTRAN, BASIC, and Assembler Programming languages. Routines in the Decimal String Arithmetic Package perform such tasks as:

- Arithmetic functions performed on decimal data strings. Strings can be as long as desired.
- Code conversion for data manipulation
- Editing for the preparation of output in special formats including insertion of commas, decimal points, dollar signs, minus signs, asterisks, and zero suppression.

USING THE ROUTINES

The Decimal String Arithmetic Routines are executed through a calling sequence from either BASIC, FORTRAN, or Assembly Language programs. The user selects the desired routine by using the routine name in the calling sequence. Parameters accompanying the subroutine call control subroutine operation. Arithmetic operations performed by the routines are performed using string variables. String variables are created by defining a one-dimensional integer array. The user then loads ASCII characters into the array (using the SPUT subroutine, for example). The number of string characters stored in the array depends upon the format chosen by the user for the data.

All arithmetic performed by arithmetic routines in the package is done using integer numbers (without fractions). For example, rather than deal in dollars and cents when multiplying monetary values, the user deals in cents only, e.g.,

$350.56 = 35056 ¢

Later, the result of arithmetic operations can be output with leading dollar signs and decimal points inserted by the SEDIT routine. A decimal number used in an arithmetic calculation using one of the arithmetic routines can be as long as desired. The user may process the entire string defined in the array, or any smaller substring within the array.

Data Formats

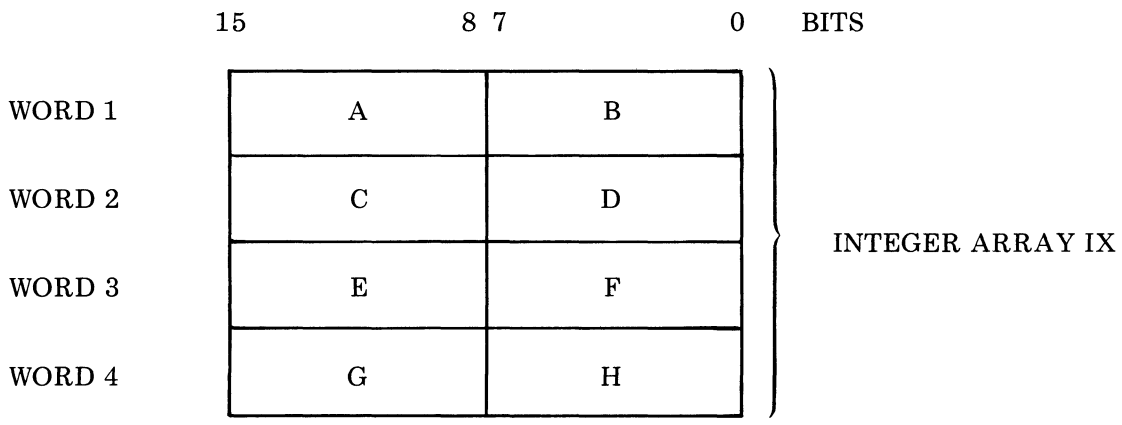
Data is stored in several different formats in integer arrays, depending upon the requirements of the Decimal String Arithmetic Routines and the user's needs. Data can be stored in one format into integer arrays using the appropriate subroutine and then converted into a different format using the conversion routines supplied as part of the package.

A2 FORMAT. Character strings stored in A2 format are stored two characters per 16-bit computer word. The characters are represented in 8-bit ASCII code. For example, to reserve space in memory for an 8-character string, the user must define an integer array four words in length. In FORTRAN, arrays are defined by a DIMENSION statement:

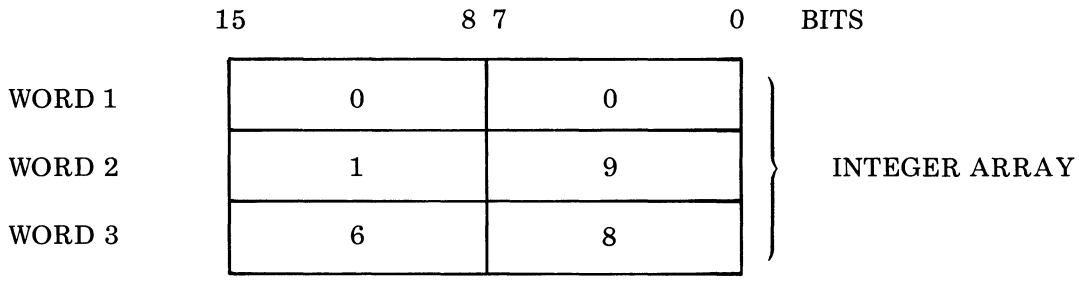
```
DIMENSION IX(4)
```

An 8-character string is stored into the integer array, IX, in the following manner:

STRING = "ABCDEFGH"



If a number is stored in A2 format (two ASCII digits per computer word), then the sign of the number (indicating whether it is positive or negative) is indicated in the rightmost digit of the string. Positive numbers are indicated by no sign at all. For example, the number 001968 is stored in an integer array as follows:

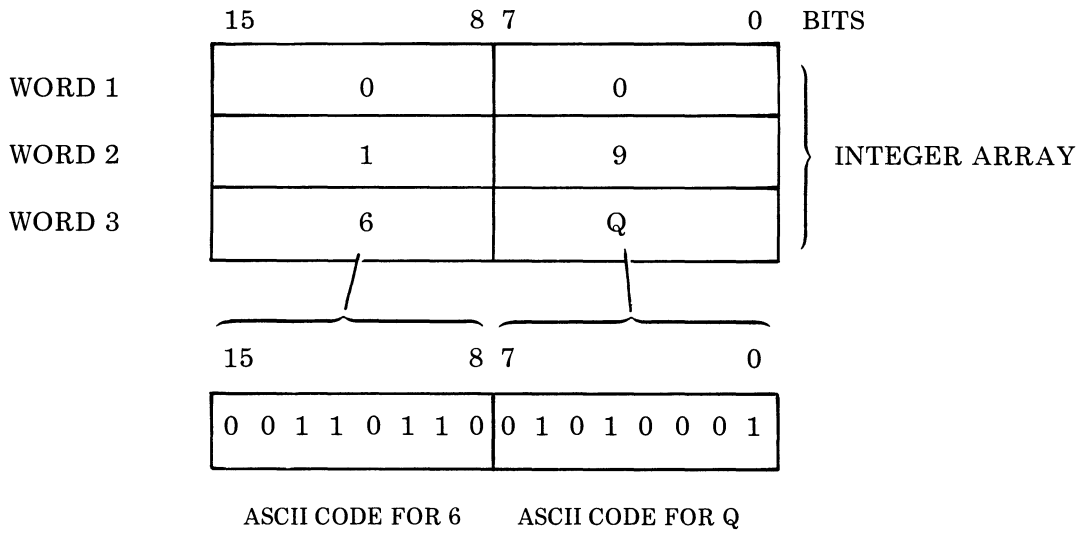


If a substring number has a negative sign, the rightmost character of the string must be represented as an 11-zone character. For example, if the rightmost character of a negative number is a 0, then the zero is changed to a minus sign to reflect the negative sign of the number. A rightmost character equal to 1 is changed to a J, and so on. Table 1-1 below shows the zoned character which must appear as the rightmost digit of a negative string, depending upon the value of the rightmost digit of the string.

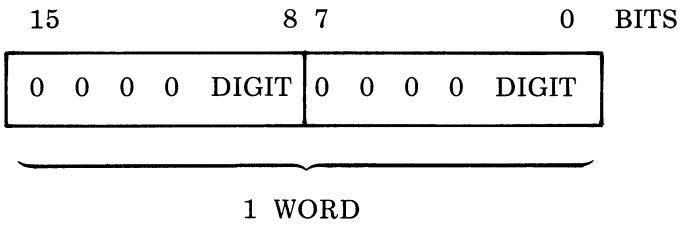
Table 1-1. Zoned Characters for Negative Strings

If the sign of the substring is negative and the rightmost digit is a:	The programmer must represent the rightmost digit as a:
0	-
1	J
2	K
3	L
4	M
5	N
6	O
7	P
8	Q
9	R

According to Table 1-1, the string -001968 is represented in an integer array as 00196Q:



D2 FORMAT. The D2 format is used to store numbers (and only numbers) in memory, and consists of two digits per 16-bit computer word:

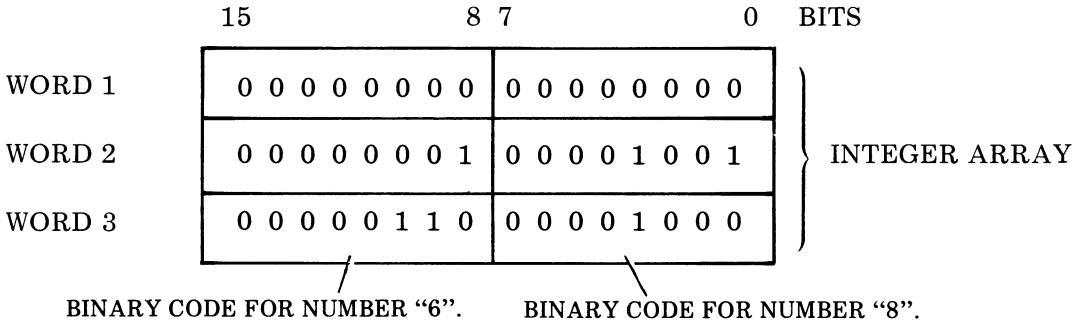


Unlike A2 format, each number is represented in binary code (as opposed to ASCII code for A2) the number is right-justified in the appropriate half-word (8-bits) and unused bits are set to zero. Table 1-2. shows the binary code for the digits 0 through 9.

Table 1-2. Binary Representation of Decimal Digits

Decimal Digit	Binary Representation
0	00000000
1	00000001
2	00000010
3	00000011
4	00000100
5	00000101
6	00000110
7	00000111
8	00001000
9	00001001

For example, the number 001968 is stored in an integer array in D2 format as follows:

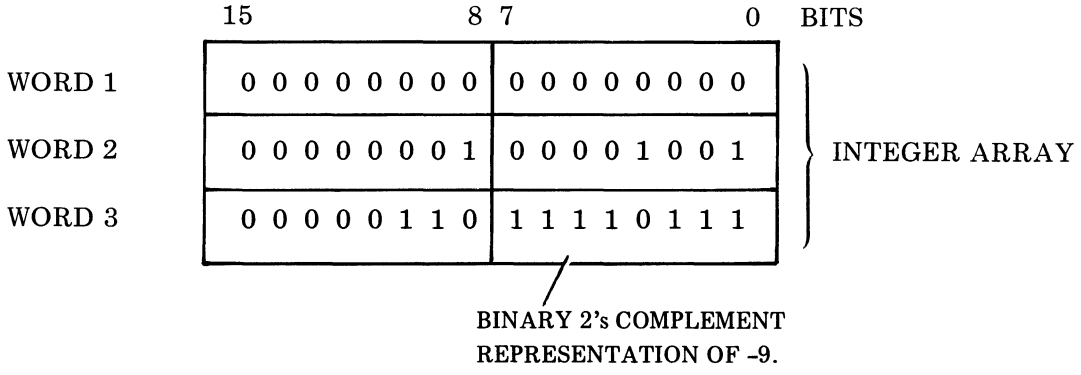


If a number is stored in D2 format, the sign of the number is indicated by the rightmost digit. Positive numbers are indicated by no sign at all. For example, the positive number 001968 is stored as shown in the previous figure. If a number has a negative sign, the negative sign is indicated in the rightmost digit. If the rightmost digit of a negative number is a 0, the user must represent the rightmost digit as a -1. A rightmost character equal to 1 is changed to -2 to reflect the negative sign, and so on. Table 1-3 below shows the digit which must appear as the rightmost digit of a negative number, depending upon the value of the rightmost digit of the number.

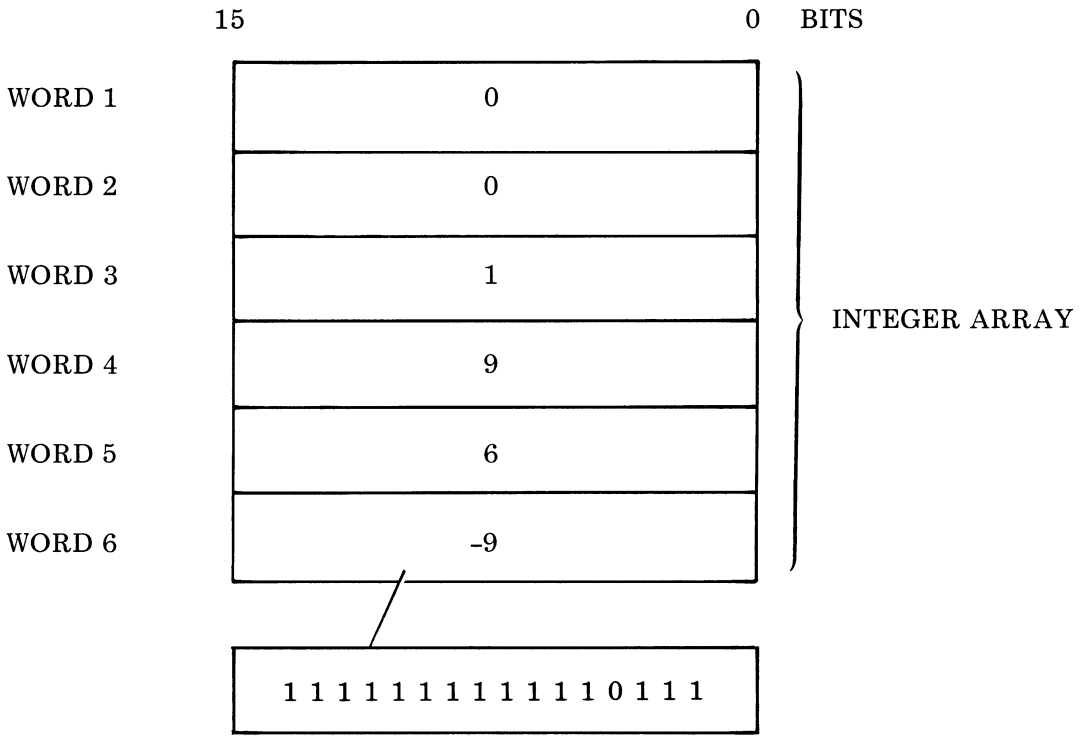
Table 1-3. Rightmost Digit for Negative Numbers

If the sign of the number is negative and the rightmost digit is a:	The rightmost digit of the number is represented as:
0	-1
1	-2
2	-3
3	-4
4	-5
5	-6
6	-7
7	-8
8	-9
9	-10

For example, the negative number -001968 is represented in an integer array as:



D1 FORMAT. D1 format is the same as D2 format except that one digit is stored in one computer word. Negative numbers are represented in the same way as in D2 format (the rightmost digit of the number is changed according to Table 1-3). For example, the number -001968 would be stored in six elements (one word per element) of an integer array as follows:



2's COMPLEMENT BINARY FOR -9.

SECTION II
String Utilities Routines

JSCOM

SUBSTRING CHARACTER COMPARE

JSCOM compares two variable-length data substrings in A2 format according to the ASCII collating sequence, and sets the result to a negative number, zero, or a positive number.

Note: JSCOM is a function subprogram and can be used in any arithmetic expression.

Format

JSCOM (JSTR, JBEG, JEND, KSTR, KBEG, IERR)

JSTR Names a one-dimensional integer string array defined in a DIMENSION statement. This array contains the first data field to be compared, in A2 format, two characters per word.

JBEG An integer constant, integer variable, or integer expression defining the position of the first character in *JSTR* to be compared (beginning of substring).

JEND An integer constant, integer variable, or integer expression defining the position of the last character in *JSTR* to be compared (end of substring). *JEND* must be greater than or equal to *JBEG*.

KSTR Names a one-dimensional integer string array defined in a dimension statement. This array contains the second data field to be compared, in A2 format, two characters per word.

KBEG An integer constant, integer variable, or integer expression defining the position of the first character in *KSTR* to be compared, (beginning of substring).

IERR An integer variable used as an error indicator. The value of *IERR* following execution of *JSCOM* indicates whether an invalid character was encountered.

Errors

If any character in JSTR or KSTR to be compared is not a valid printable ASCII character, IERR is set to the position of the current character in JSTR, and JSCOM is set to one; otherwise IERR remains unchanged. See the list of valid characters in Appendix A.

EXAMPLE

```
        DIMENSION ITEMA (5), ITEMB (6)
        IERR=0
        IF (JSCOM(ITEMA,1,10,ITEMB,3,IERR))1,2,3
1       ITEMA substring is less than ITEMB substring
2       ITEMA substring is equal to ITEMB substring
3       IF (IERR)5,4,5
4       ITEMA substring is greater than ITEMB substring
5       Error routine
        .
        .
        .
ITEMA   0001335689
ITEMB   000001335791
```

ITEMA, from positions 1 through 10, is compared character by character with ITEMB, positions 3 through 12. If the ITEMA field is less than the ITEMB field, control goes to statement 1.

If the ITEMA field is equal to the ITEMB field, control goes to statement 2. If the ITEMA field is greater than the ITEMB field or if an illegal character was encountered, control goes to statement 3, where a test may be made for the error condition.

Comments

The collating sequence used in the comparison is given in Appendix A. It is in ascending order and constitutes the entire set of valid ASCII characters.

Corresponding characters in JSTR and KSTR are compared logically according to the collating sequence given in Appendix A. Comparison starts with the JBEG and KBEG positions and proceeds from left to right. The comparison is finished with the first pair of characters that do not match, or when the character at JSTR (JEND) has been compared.

JSCOM is set when the comparison terminates according to the following:

JSCOM	Result of Comparison
– (minus)	JSTR substring is less than KSTR substring
0 (zero)	JSTR substring is equal to KSTR substring
+ (plus)	JSTR substring is greater than KSTR substring

It is the user's responsibility to set, test, and reset IERR.

SFILL

SUBSTRING FILL

SFILL fills a specified area in a substring array with a specified character.

Format

CALL SFILL (JSTR, JBEG, JEND, JCD)

JSTR Names a one-dimensional integer string array containing the area of the substring to be filled. The array must be defined in a DIMENSION statement.

JBEG Integer constant, integer variable, or integer expression defining the position of the first character in *JSTR* to be filled (beginning of substring).

JEND Integer constant, integer variable, or integer expression defining the position of the last character in *JSTR* to be filled (end of substring). *JEND* must be greater than or equal to *JBEG*.

JCD Integer constant, integer variable, or integer expression containing the ASCII code for the fill character.

Errors

None.

EXAMPLE

```
DIMENSION IPRIN (13)
JCD = 000052B
CALL SFILL (IPRIN,9,15,JCD)
```

Before

		1		2		3		4		5		6		7		8		9		10		11		12		13	
IPRIN	*Data*	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

After

		1		2		3		4		5		6		7		8		9		10	
IPRIN	*Data*	0	1	2	3	4	5	6	7	*	*	*	*	*	*	*	5	6	7	8	9
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18	20

The array IPRIN is filled with asterisks from positions 9 through 15.

To fill the array IPRIN with blanks, the following code and parameters are specified:

```
ICD = 000040B
CALL SFILL(IPRIN,1,26,ICD)
```

SGET

SUBSTRING GET

SGET gets a specified character from a substring.

Format

CALL SGET (JSTR, J, JHOLD)

JSTR Names a one-dimensional integer string array containing the area of the requested character. The array must be defined in a DIMENSION statement.

J Integer constant, integer variable, or integer expression defining the position of the specified character in *JSTR*.

JHOLD Integer variable or integer expression containing the specified character, zero-filled, right-justified (after SGET is executed).

Errors

None.

Comments

The character in position J of JSTR is returned in JHOLD, right-justified, zero-filled.

EXAMPLE

```
DIMENSION IPRIN(10)
.
.
.
CALL SGET (IPRIN,6,NCHAR)
```

Before

	Word	1		2		3		4		5		6		7		8		9		10	
IPRIN	*Data*	0	2	4	6	8	3	5	7	9	A	B	C	D	E	F	G	H	I	J	K
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

After

IPRIN unchanged
NCHAR - 000063_8 (ASCII 3)

SMOVE

SUBSTRING MOVE

SMOVE to moves data from one string array to another.

Format

CALL SMOVE (JSTR, JBEG, JEND, KSTR, KBEG)

JSTR Names a one-dimensional integer string array containing the data to be moved. The array must be defined in a DIMENSION statement. The data may be any format that is two characters per word.

JBEG Integer constant, integer variable, or integer expression defining the position of the first character to be moved, (beginning of substring).

JEND Integer constant, integer variable, or integer expression defining the position of the last character in *JSTR* to be moved, (end of substring). *JEND* must be greater than or equal to *JBEG*.

KSTR Names a one-dimensional integer array, in any format that is two characters per word, into which the data from *JSTR* is moved. It must be defined in a DIMENSION statement.

KBEG Integer constant, integer variable, or integer expression defining the first character position in *KSTR* to which data from *JSTR* is moved (beginning of substring).

Errors

None.

Comments

Each character in JSTR beginning with position JBEG and ending with JEND is moved to KSTR beginning at position KBEG.

EXAMPLE

```
DIMENSION ICARD(80), ILINE(120)
I =  2
J = 13
K = 10
CALL SMOVE(ICARD,I,J,ILINE,K)
```

Before

	Word	1		2		3		4		5		6		7		8		9		10		11		12		13	
ICARD	*Data*	0	1	X	Y	Z	A	B	C	0	0	0	5	7	8	1	3	7	6	5	△	△	0	0	7	3	9
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

	Word	1		2		3		4		5		6		7		8		9		10		11		12		13	
ILINE	*Data*	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

After

ICARD *No change*

	Word	1		2		3		4		5		6		7		8		9		10		11		12		13	
ILINE	*Data*	△	△	△	△	△	△	△	△	△	1	X	Y	Z	A	B	C	0	0	0	5	7	△	△	△	△	△
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

The field in the array ICARD beginning at character 2 and ending with character 13 as defined by the variables I and J, is moved to ILINE starting with character 10 as defined by the variable K.

A total of 12 characters was moved.

SPUT

SUBSTRING PUT

SPUT puts a specified character in a specified position of a substring.

Format

CALL SPUT (JSTR, J, JHOLD)

JSTR Names a one-dimensional integer string array into which the requested character is to be placed. The array must be defined in a dimension statement.

J Integer constant, integer variable, or integer expression defining the position in *JSTR* where the specified character is to be placed.

JHOLD Integer variable or integer expression containing the character, to be transferred right-justified, zero-filled.

Errors

None.

Comments

JHOLD remains unchanged after the transfer.

EXAMPLE

```
DIMENSION IPRIN(5)
NCHAR=000060
CALL SPUT(IPRIN,7,NCHAR)
```

Before

	Word	1		2		3		4		5	
IPRIN	*Data*	0	2	4	6	8	1	5	3	7	9
	String	1	2	3	4	5	6	7	8	9	10

NCHAR = 000060

After

	Word	1		2		3		4		5	
IPRIN	*Data*	0	2	4	6	8	1	0	3	7	9
	String	1	2	3	4	5	6	7	8	9	10

NCHAR = 000060

SZONE

SUBSTRING ZONE

SZONE finds the zone-punch of a character, sets a code to indicate what the zone is and provides a new zone.

Format

CALL SZONE (JSTR, JBEG, NEZ, NOZ)

JSTR Names a one-dimensional integer string array containing the character whose zone is to be tested and modified. It must be defined in a DIMENSION statement. The character must be in A2 format, two characters per word.

JBEG Integer constant, integer variable, or integer expression defining the position of the character in *JSTR* to be tested and modified.

NEZ Integer constant, integer variable, or integer expression specifying a code for the new zone.

NOZ Integer variable which is set to a code indicating the original zone of the character.

Errors

None.

Comments

First, the zone of the character at position JBEG is retrieved and NOZ is set as follows:

NOZ	Original Zone	Character
1	12-zone	A–I
2	11-zone	–,J–R
3	0-zone	/,S–Z
4	no zone	+,0–9
more than 4		special

A new zone is then inserted as specified by NEZ in the table below:

NEZ	New Zone	Character
1	12-zone	A–I
2	11-zone	–,J–R
3	0-zone	/,S–Z
4	no zone	+,0–9
more than 4		special

No change is made to the zone when the character is a special character.

The minus sign or hyphen (– or an 11-zone punch) is not treated as a special character. It is assumed to be a negative zero. The only modification that can be made to a – (minus, or negative zero) is to change it to an unsigned zero with a no zone code. Zero (0) and + (plus) are treated as no-zone characters; however, the only modification that can be made to a zero (0) or plus (+) is to change it to a minus (–) upon request for an 11-zone punch. Plus is changed to zero upon request for a no-zone punch. Upon request for any other zero punch, zero (0) and plus (+) remain unchanged. These are the only exceptions among the special characters.

EXAMPLE

```
DIMENSION ICHAR(80)
CALL NZONE (ICHAR,8,1,I)
```

Before

```
ICHAR(8) = R (11–9 punch)
I=0
```

After

```
ICHAR(8) = I (12–9 punch)
I=2
```

Table 2-1. SZONE Conversion

OLD CHARACTER	NEW CHARACTER NEZ					NOZ
	1	2	3	4	5	
A	A	J	/	1	A	1
B	B	K	S	2	B	1
C	C	L	T	3	C	1
D	D	M	U	4	D	1
E	E	N	V	5	E	1
F	F	O	W	6	F	1
G	G	P	X	7	G	1
H	H	Q	Y	8	H	1
I	I	R	Z	9	I	1
J	A	J	/	1	J	2
K	B	K	S	2	K	2
L	C	L	T	3	L	2
M	D	M	U	4	M	2
N	E	N	V	5	N	2
O	F	O	W	6	O	2
P	G	P	X	7	P	2
Q	H	Q	Y	8	Q	2
R	I	R	Z	9	R	2
/	A	J	/	1	/	3
S	B	K	S	2	S	3
T	C	L	T	3	T	3
U	D	M	U	4	U	3
V	E	N	V	5	V	3
W	F	O	W	6	W	3
X	G	P	X	7	X	3
Y	H	Q	Y	8	Y	3
Z	I	R	Z	9	Z	3
0	0	-	0	0	0	4
+	+	-	+	0	+	4
-	-	-	-	0	-	2
1	A	J	/	1	1	4
2	B	K	S	2	2	4
3	C	L	T	3	3	4
4	D	M	U	4	4	4
5	E	N	V	5	5	4
6	F	P	W	6	6	4
7	G	P	X	7	7	4
8	H	Q	Y	8	8	4
9	I	R	Z	9	9	4
special character	same special character					5

SECTION III
String Arithmetic Routines

SADD

SUBSTRING DECIMAL ADD

SADD adds two character substrings of arbitrary length and stores the result in the second substring. Refer to Appendix B for the BASIC calling sequence.

Format

CALL SADD (JSTR, JBEG, JEND, KSTR, KBEG, KEND, IERR)

JSTR Names a one-dimensional integer string array containing the first character substring to be added. The contents of the array must be in A2 format, two characters per word. *JSTR* must be defined in a DIMENSION statement.

JBEG An integer constant, integer variable or integer expression indicating the position of the first character in *JSTR* to be added (beginning of substring).

JEND An integer constant, integer variable or integer expression giving the position of the last character in *JSTR* to be added (end of substring). It must be greater than or equal to *JBEG*.

KSTR Names a one-dimensional integer string array containing the data to which the data in *JSTR* is added. It will contain the result following addition in A2 format, two characters per word. *KSTR* is defined in a DIMENSION statement.

KBEG An integer constant, integer variable or integer expression giving the position of the first character in *KSTR* (beginning of substring).

KEND An integer constant, integer variable, or integer expression giving the position of the last character in *KSTR* (end of substring). It must be greater than or equal to *KBEG*.

IERR An integer variable used as an error indicator. The value of *IERR* following execution of SADD indicates whether arithmetic overflow occurred: If an overflow occurred, *IERR* is set equal to *KEND*. The programmer must initialize, test and reset *IERR*.

Errors

IERR is set when

- There was arithmetic overflow: if KSTR is not large enough to contain the sum, the KSTR field is filled with 9's and IERR is made equal to KEND.
- JSTR is longer than KSTR, neither field is altered, but IERR is set equal to KEND.
- Either substring of JSTR and/or KSTR do not contain all ASCII numeric characters (except the rightmost character), IERR is set equal to -1.

Comments

JSTR and KSTR can be any length up to the maximum space available; KSTR must, however, be greater than JSTR in order to avoid an overflow condition.

The characters in JSTR and KSTR must all be ASCII numeric, 0-9 except the rightmost character, JLAST or KLAST, which may be an 11-zone character, indicating a negative digit.

It is the user's responsibility to initialize, test, and reset IERR.

EXAMPLE

```
DIMENSION IFLDA(8),IFLDB(10)
IE = 0
CALL SADD(IFLDA,1,15,IFLDB,1,20,IE)
```

Before

IFLDA =

	1		2		3		4		5		6		7		8	
Word																
Data	△	△	△	△	△	3	7	1	4	1	0	0	2	5	1	6
String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

IFLDB =

	1		2		3		4		5		6		7		8		9		10	
Word																				
Data	△	△	△	1	5	3	4	6	7	8	9	3	5	0	0	0	9	8	7	6
String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

IE = 0(zero)

After

IFLDA No change

IFLDB =

	1		2		3		4		5		6		7		8		9		10	
Word																				
Data	0	0	0	1	5	3	4	6	7	9	3	0	6	4	1	1	0	1	2	7
String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

IE = 0(zero)

The data field IFLDA is added to IFLDB and the result placed in IFLDB. The error indicator IE is unchanged since no overflow occurred.

Note: At the conclusion of SADD, the rightmost character in KSTR, KLAST, carries the sign of the sum. Thus, if the sum is negative, the rightmost character will be an 11-zone character. However, if the sum is zero, the rightmost character may be either 0 (zero) or - (minus sign).

SDIV

SUBSTRING DECIMAL DIVISION

SDIV divides arbitrary length substring KSTR by another such substring JSTR, placing the quotient and the remainder in KSTR. Refer to Appendix B for the BASIC calling sequence.

Format

CALL SDIV (JSTR, JBEG, JEND, KSTR, KBEG, KEND, IERR)

JSTR Names a one-dimensional integer string array used as the divisor. It must contain data in A2 format, two characters per word. *JSTR* must be defined in a DIMENSION statement.

JBEG Integer constant, integer variable, or integer expression giving the position of the first digit of *JSTR* (beginning of substring).

JEND Integer constant, integer variable, or integer expession giving the position of the last digit of *JSTR* (end of substring). *JEND* must be greater than or equal to *JBEG*.

KSTR Names a one-dimensional integer string array used as the dividend. It will contain the quotient and the remainder, extended to the left, following division. The data is in A2 format, two digits per word.

KBEG Integer constant, integer variable, or integer expression giving the position of the first digit of *KSTR* (beginning of substring).

KEND Integer constant, integer variable, or integer expression giving the position of the last digit of *KSTR* (end of substring). It must be greater than or equal to *KBEG*.

IERR An integer variable used as an error indicator. After SDIV is executed, it indicates whether division by zero was attempted, or whether the field *KSTR* was too small to contain quotient and remainder.

Errors

IERR is set in one of three circumstances:

1. If division by zero was attempted, IERR is set to KEND
2. If either substring of JSTR and/or KSTR does not contain all ASCII numerics. except the rightmost character, IERR is set to –1.
3. If insufficient space was allocated to extend KSTR to the left, IERR is set to KEND.
4. If the length of the divisor is greater than the length of the dividend, IERR is set to KEND.

In all above cases, neither KSTR nor JSTR is modified.

Comments

JSTR and KSTR can be any length up to the maximum space available. Sufficient space must be allocated to KSTR to allow for its extension. At least (KEND–KBEG+1) + 2(JEND–JBEG+1) positions must be provided between the beginning of KSTR and the first dividend position KBEG. For instance, if JEND=6, JBEG=2 (the divisor has 5 positions) and the dividend has 7 positions, then KBEG must be at least 18 positions from the beginning of KSTR.

The user is responsible for initializing, testing, and resetting the error indicator, IERR.

The quotient and the remainder will both be located in the extended KSTR field according to the diagram below:

```
KSTR        Quotient          Remainder
            ↑   ↑   ↑         ↑         ↑
            A   K   B         C         D
```

A is the position: KBEG– (JEND–JBEG+1)
K is the position: KBEG
B is the position: KEND– (JEND–JBEG+1)
C is the position: KEND– (JEND–JBEG)
D is the position: KEND

The SDIV arithmetic is decimal arithmetic using whole numbers only, with no decimal point alignment. Therefore, the numbers should have an assumed decimal point following the rightmost digit.

(See also "*Short-String Routine*" in the SMPY description.)

EXAMPLE

Divide 7943074 by –42135

```
DIMENSION IDIVR(3), IDVD(12)
IE=0
CALL SDIV(IDIVR,2,6,IDVD,18,24,IE)
```

Before

IDIVR

	Word	1		2		3	
	Data	A	4	2	1	3	N
	String	1	2	3	4	5	6

Note: 11 –zone 5 ,(N), stands for –5 in A2 formats

IDVD

	Word	1		2		3		4		5		6		7		8		9		10		11		12	
	Data	A	B	C	D	E	F	G	H	I	J	K	L	M	N	0	0	0	7	9	4	3	0	7	4
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

After

IDIVR No Change

IDVD

	Word	1		2		3		4		5		6		7		8		9		10		11		12	
	Data	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	Q	2	1	6	9	4
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

**—— Quotient —— * —Remainder*

Answer: –188, remainder 21694

IE=0 (zero)

The numeric field IDIVR was divided by the numeric field IDVD with the quotient and remainder placed in IDVD. The field IDVD has been extended 17 places to the left and filled with zeros. The remainder is in the 5 low order positions of IDVD, the quotient in positions 13 through 19.

Note: See SMPY for a routine which enables the user to provide a shorter string for the dividend.

SMPY

SUBSTRING DECIMAL MULTIPLY

SMPY multiplies two character data substrings and places the result in the second substring. The substrings may be any length. Refer to Appendix B for the BASIC calling sequence.

Format

CALL SMPY (JSTR, JBEG, JEND, KSTR, KBEG, KEND, IERR)

JSTR Names a one-dimensional integer string array containing the data to be multiplied. The array must be defined in a DIMENSION statement. The data is in A2 format two characters per word.

JBEG Integer constant, integer variable, or integer expression defining the position of the first character in *JSTR* to be multiplied (beginning of substring).

JEND Integer constant, integer variable, or integer expression defining the position of the last character in *JSTR* to be multiplied (end of substring). *JEND* must be greater than or equal to *JBEG*.

KSTR Names a one-dimensional integer string array containing the multiplicand. After multiplication, it will contain the product extended to the left. The data, before and after multiplication, is in A2 format, two characters per word.

KBEG Integer constant, integer variable, or integer expression defining the position of the first character in the multiplicand (beginning of substring).

KEND Integer constant, integer variable, or integer expression defining the position of the last character in both the multiplicand and the product (end of substring). *KEND* must be greater than or equal to *KBEG*.

IERR Integer variable used as an error indicator. It is set to *KEND* when *KSTR* is not large enough to contain the product.

Errors

If KSTR does not have enough positions to allow for its extension to the left in order to receive the product, IERR is set equal to KEND. The subroutine terminates at that point. If JSTR or KSTR contain a non-numeric or non-blank character in other than the last position, IERR is set to –1. In either case, neither JSTR nor KSTR is modified. The user is responsible for testing and resetting IERR.

Comments

The data is converted from ASCII to numeric within SMPY.

JSTR and KSTR can be any length up to the maximum space available. Sufficient space must be allocated to KSTR to allow for its extension. At least (KEND–KBEG+1)+2(JEND–KBEG+1) positions must be provided between the beginning of KSTR and the first multiplicand position KBEG. That is, if JSTR has five positions (for example, JEND=6, JBEG=2) and the multiplicand has 7 positions, then KBEG must be at least 18 positions from the beginning of KSTR; KBEG would be greater than or equal to 18.

The SMPY arithmetic is decimal arithmetic using whole numbers only.

The product of SMPY is located in KSTR beginning at position KBEG and ending at position KEND.

EXAMPLE

```
DIMENSION MULTR(3), MLCND(13)
IE = 0
CALL SMPY (MULTR,2,6,MLCND,18,24,IE)
```

Before

	Word	1		2		3	
MULTR	*Data*	0	0	1	5	4	0
	String	1	2	3	4	5	6

	Word	1		2		3		4		5		6		7		8		9		10		11		12		13	
MLCND	*Data*	V	W	X	Y	Z	C	D	E	F	G	H	I	J	K	L	R	S	0	8	6	5	8	3	2	A	B
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

IE = 0

After

MULTR No Change

	Word	1		2		3		4		5		6		7		8		9		10		11		12		13	
MLCND	*Data*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	3	3	3	8	1	2	8	0	A	B
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

IE = 0

The numeric data fields MULTR and MLCND are multiplied and the result placed in MLCND. The field MLCND has been extended to the left 17 characters and filled with zeros. IE has not been changed. The result starts the number of positions in MULTR to the left of KBEG but the field was extended and zero-filled 2(JEND-JBEG+1) + (KEND-KBEG+1) positions.*

Short-String Routine

If the user does not wish to provide such a long string for KSTR, he may use the following instructions with SMPY:

```
MAINLINE
      .
      .
      .
N1=2*(JEND–JBEG+1)+(KEND–KBEG+1)+1
N2=N1+(KEND–KBEG)
CALL SMOVE(KSTR, KBEG, KEND, KTEMP, N1)
CALL SMPY(JSTR,JBEG,JEND,KTEMP,N1,N2,IERR)
N3=N1–(JEND—JBEG+1)
N4=KBEG– (JEND–JBEG+1)
CALL SMOVE (KTEMP,N3,N2,KSTR,N4)
      .
      .
      .
```

KSTR must be dimensioned, and at least (JEND–JBEG+1) positions must be provided between the beginning of KSTR and the first multiplicand position, KBEG, to allow for the extension of the product. That is, if JSTR has 5 positions (for example, JEND=6, JBEG=2), and the multiplicand has 7 positions, then KBEG must be greater than or equal to 6. KTEMP is a temporary buffer to which the multiplicand is moved to allow for its expansion during SMPY. It must be dimensioned by the user, and must consist of at least 2(KEND–KBEG+1) + 2(JEND–JBEG+1) positions.

Note: The short-string routine also can be used with SDIV.

EXAMPLE

```
DIMENSION MULTR(3),MLCND(6),MTEMP(12)
IE=0
JBEG=2
JEND=6
KBEG=6
KEND=12
N1=2*(JEND-JBEG+1)+(KEND-KBEG+1)+1
N2=N1+(KEND-KBEG)
CALL SMOVE(MLCND,KBEG,KEND,MTEMP,N1)
CALL SMPY(MULTR,JBEG,JEND,MTEMP,N1,N2,IE)
N3=N1- (JEND-JBEG+1)
N4=KBEG- (JEND-JBEG+1)
CALL SMOVE(MTEMP,N3,N2,MLCND,N4)
```

Before

MULTR

Word	1		2		3	
Data	0	0	1	5	4	0
String	1	2	3	4	5	6

MLCND

Word	1		2		3		4		5		6	
Data	J	K	L	R	S	0	8	6	5	8	3	2
String	1	2	3	4	5	6	7	8	9	10	11	12

IE=0

After

MLCND

Word	1		2		3		4		5		6	
Data	0	0	1	3	3	3	3	8	1	2	8	0
String	1	2	3	4	5	6	7	8	9	10	11	12

IE=0

SSUB

SUBSTRING SUBTRACT

SSUB subtracts one substring from a second substring and places the result in the second substring. Both substrings may be of any length. Refer to Appendix B for the BASIC calling sequence.

Format

CALL SSUB (JSTR, JBEG, JEND, KSTR, KBEG, KEND, IERR)

JSTR Names a one-dimensional integer string that is to be subtracted from a second array. The array must be defined in a DIMENSION statement. The contents of the array must be in A2 format, two characters per word.

JBEG Integer constant, integer variable, or integer expression defining the position of the first character to be subtracted (beginning of substring).

JEND Integer constant, integer variable, or integer expression defining the position of the last character to be subtracted (end of substring). *JEND* must be greater than or equal to *JBEG*.

KSTR Names a one-dimensional integer string array containing the data from which the data in *JSTR* is subtracted. It will contain the result following subtraction. The array must be defined in a DIMENSION statement.

KBEG Integer constant, integer variable, or integer expression defining the position of the first character in *KSTR* (beginning of substring).

KEND Integer constant, integer variable, or integer expression defining the position of the last character in *KSTR* (end of substring). *KEND* must be greater than or equal to *KBEG*.

IERR Integer variable used as an error indicator. Upon completion of SSUB, *IERR* indicates whether arithmetic overflow has occurred.

Errors

If there was arithmetic overflow (KSTR was not large enough to contain the result, IERR is set to KEND. KSTR is filled with 9's.

If JSTR is longer than KSTR, neither field is altered, but IERR is set equal to KEND and SSUB terminates.

If either data field, except JLAST and KLAST, is not numeric ASCII, IERR is set to –1 and SSUB terminates.

Comments

See comments for SADD.

EXAMPLE

```
DIMENSION IFLDA(8), IFLDD(10)
IE = 0
CALL SSUB(IFLDA,1,8,IFLDB,1,16,IE)
```

Before

IFLDA

Word	1		2		3		4		5		6		7		8	
Data	1	5	6	4	3	0	5	5	△	△	△	△	△	△	△	△
String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

IFLDB

Word	1		2		3		4		5		6		7		8		9		10	
Data	0	0	0	0	7	2	3	5	7	9	8	3	4	0	5	0	0	0	0	0
String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

IE = 0

After

IFLDA No Change

IFLDB

Word	1		2		3		4		5		6		7		8		9		10	
Data	0	0	0	0	7	2	3	5	6	4	1	9	0	9	9	5	0	0	0	0
String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

IE = 0

The decimal data field IFLDA is subtracted from the decimal data field IFLDB and the result placed in IFLDB. Since IFLDA is positive, it is made negative and then added to IFLDB producing the result.

The error indicator IE is unchanged since no overflow occurred.

SECTION IV
Output Editing Routine, SEDIT

SEDIT

SEDIT edits data in one substring array using an edit mask in a second substring array and places the edited data in the second substring array. Refer to Appendix B for the BASIC calling sequence.

Format

CALL SEDIT (JSTR, JBEG, JEND, KSTR, KBEG, KEND)

JSTR Names a one-dimensional integer string array containing the data to be edited. The array must be defined in a DIMENSION statement. The data to be edited, called the source field, is in A2 format two characters per word.

JBEG Integer constant, integer variable, or integer expression defining the position of the first character of *JSTR* to be edited (beginning of substring).

JEND Integer constant, integer variable, or integer expression defining the position of the last character of *JSTR* to be edited (end of substring). *JEND* must be greater than or equal to *JBEG*.

KSTR Names a one-dimensional integer string array containing the edit mask and into which the data is edited. The edit mask, called - the mask field, is in A2 format, two characters per word.

KBEG Integer constant, integer variable, or integer expression defining the first position of the mask field (beginning of substring).

KEND Integer constant, integer variable, or integer expression defining the last position of the mask field (end of substring). It must be greater than *KBEG*.

Alphanumeric Editing

X(ALPHANUMERIC REPLACEMENT HOLDER). Alphanumeric edit masks are used to edit character substrings and consist of X's as replacement holders and any other character as insertion characters. Characters are placed in the edit mask from right to left. Each replacement holder(X) in the edit mask is replaced in the display result with a character from the substring. Each insertion character (anything other than X) in the edit mask appears unmodified in the display result. If the end of the mask is reached before the end of the character substring, the remaining characters in the elements are not displayed. If the end of the character substring is reached first, the remainder of the display is replaced by asterisks. The character substring must be defined as ASCII if using the alphanumeric edit mask.

EXAMPLES:

Character Substring	*Edit Mask*	*Edited Result*
MNRZ	*"X-XX-X"*	*M-NR-Z*
MNRZ	*"XXX"*	*NRZ*
MNRZ	*"XX/XX/XX"*	***/MN/RZ*

Numeric Editing

Numeric edit masks are used to edit ASCII numeric, 0-9. Numeric edit masks consist of replacement holders, sign characters and insertion characters.

Replacement

9 (NUMERIC REPLACEMENT HOLDER). Each 9 in the edit mask is replaced by a decimal digit in the corresponding position of the numeric substring.

Z (ZERO SUPPRESSION REPLACEMENT HOLDER). The position of the Z in the edit mask is replaced by a decimal digit in the corresponding position of the numeric substring. Zeros to the left of the first significant position in the substring are replaced by blanks.

*** (ASTERISK REPLACEMENT HOLDER).** Asterisks rather than blanks are inserted to the left of the first significant decimal digit in the substring.

$ (DOLLAR SIGN REPLACEMENT HOLDER). A dollar sign is inserted to the left of the first significant decimal digit in the substring, and is to the left of the position that defined the zero suppression. Any zero in the remaining non-significant positions are replaced by blanks.

Sign Characters

CR(CREDIT). These two characters are placed in the rightmost positions of the edit mask. If the decimal substring is negative, the characters remain in the edited output. If the substring value is positive, CR is replaced by two blanks. When CR is present in the edit mask, no data is edited into the last two positions but only into the edit characters to the left.

– (MINUS). This character placed in the rightmost position of the edit mask is treated similarly to CR. It remains if the substring value is negative; is replaced by a blank when the substring value is positive. A minus elsewhere in the edit mask remains in that position in the edited output.

Insertion Characters

All other characters in the edit mask not defined above are insertion characters.

Operation of SEDIT

The characters are placed in the edit mask from right to left. Only the characters 9, Z, *, and $ are replaced by decimal characters in the substring.

If the characters CR or a minus are in the rightmost position or positions, they are made blank for a positive substring value and left unchanged for a negative substring value.

If all the substring characters have not been placed in the edit mask when the end of the edit mask is reached, the entire edited output is filled with asterisks and editing terminates. Zero suppression proceeds from left to right of the edit mask. Any of the edit mask characters: 9, Z, X,. (decimal point), or, (comma) is replaced by a blank unless the zero suppression character is an asterisk in which case it is replaced by an asterisk.

Rules Governing Creation of Edit Mask

There must be no more than one decimal point. Zero suppression is used when the edit mask contains a Z(zero), *(asterisk), or $(dollar sign) and:

1. A Z may not appear anywhere after a 9, *, or $ which is not the first holder in the edit mask.

2. A * may not appear anywhere after a 9, Z or $ which is not the first holder in the edit mask.

3. A $ may not appear anywhere after a Z, 9, or *.

In editing a numeric data substring through a numeric edit mask, the digits which represent the value of the substring are exchanged for the replacement holder. The decimal point remains in the edited output where it was placed in the edit mask. If, however, zero suppression is also requested, it is replaced by a blank if it is to the left of the last character to be suppressed.

Any insertion character appears unmodified in the display unless it is a decimal point or comma with zero suppression.

EXAMPLES

Substring Value	*Edit Mask*	*Edited Result*
0059	*"$$$,999"*	*$059*
1024	*"ZZZ,ZZZ"*	*1,024*
010555	*"$$,$$$.99CR"*	*$105.55*
01055N (-010555)	*"$$,$$$.99CR"*	*$105.55CR*
01055N (-010555)	*"$$,$$$.99-"*	*$105.55-*
010555	*"$$,$$$.99-"*	*$105.55*
15039250	*"$,$$$,$$$.99CR"*	*$150,392.50*
139R (-1399)	*"*,***.99CR"*	****13.99CR*
044240474	*"999-99-9999"*	*044-24-0474*
214N(-2145)	*"$,$$$.99"*	*$21.45*
24	*"999.99"*	*000.24*
24	*"9.99.9"*	****0.24*
1234	*"X.XX.X"*	*1.23.4*

Errors

When the number of characters in the source field is greater than the number of characters in the mask substring, the mask substring is filled with asterisks and editing terminates.

In numeric edits, if more than one decimal point is encountered, the mask substring will be filled with stars from the place of the second decimal point to the left most position of the substring.

Each execution of SEDIT destroys the mask field by replacing it with the edited result. It is therefore, advisable to move the mask to the output area and perform the edit function in the output area.

SECTION V
Internal Routines

SA2DE

SUBSTRING A2 FORMAT TO DECIMAL

SA2DE converts a field from A2 format to decimal format; A2 format is two-characters per word; decimal format is two digits per word.

NOTE: This routine is not normally called by the user. It is used by the variable-length decimal string arithmetic subroutines: SADD, SSUB, SMPY, and SDIV.

Format

CALL SA2DE (JSTR, JBEG, JEND, IERR)

JSTR Names the one-dimensional integer string array in A2 format that is to be converted to decimal. The array must be defined in a DIMENSION statement.

JBEG An integer constant, integer variable, or integer expression defining the first character position in *JSTR* to be converted (beginning of substring).

JEND An integer constant, integer variable, or integer expression defining the last character position in *JSTR* to be converted (end of substring). *JEND* must be greater than or equal to *JBEG*.

IERR An integer variable used as error indicator. If all characters are valid, *IERR* is unchanged; otherwise it is set to the *last* invalid character found during conversion.

Errors

When an invalid character is found, the position of the character is placed in IERR. (A non-numeric or non-blank character is invalid; an 11-zone character representing a sign in the JEND position of JSTR is valid.) If more than one invalid character is found, IERR is set to the most recent position, and processing continues.

Comments

Only the *last* invalid character is indicated in IERR when conversion is complete. Other invalid characters may have been found in preceding positions.

Blanks are converted to zeros.

Zone punches may be used to indicate conditions. These punches can be removed with the SZONE routine as shown in the error routine following the example.

EXAMPLE

```
DIMENSION INFL(10)
IE = 0
CALL SA2DE (INFL,7,17,IE)
```

INFL is originally in A2 format. After execution of SA2DE, positions 7-17 of INFL have been converted to decimal format (blanks are converted to zeros). Since no invalid characters were found, IE is unchanged. The field to be converted was originally

△△△△012345J

The field after conversion is

00000123451̄

EXAMPLE

In order to remove zone punches, use the following routine:

```
      MAINLINE
      .
      .
      .
11    CALL SA2DE (JARY, JBEG, JEND, IERR)
      IF  (IERR)22,22,32
22    (CONTINUE MAINLINE)
      .
      .
      .
```

```
32      (ERROR ROUTINE)
        .
        .
        .
        CALL SZONE (JARY,IERR,4,N1)
        N1 = 0
        CALL SA2DE (JARY,IERR,IERR,N1)
        IF (N1)50,50,40
40      STOP 999
50      CALL SDEA2 (JARY,JBEG,JEND,IERR)
        IERR = 0
        GO TO 11
```

When IERR is greater than zero, control transfers to statement 32. Unless the zone is a special character, it is removed with the SZONE routine and converted to decimal. If the character was a special character (truly invalid), the program halts at statement 40. Otherwise, control goes to statement 50 where the field is returned to A2 format. Control then returns to statement 11 where the field is again converted to decimal in an attempt to find other invalid characters.

This process continues until no more errors are found or a truly invalid character is encountered. The error indicator is not reset by this routine but must be reset by the programmer.

SCARY

SUBSTRING D2 DECIMAL CARRY

SCARY examines a specified D2 decimal substring for carries, resolves the carries in the next higher substring, and saves any carry from the high-order digit of the substring.

NOTE: This routine normally is not called by a user.

Format

CALL SCARY (JSTR, JBEG, JEND, KOUT)

JSTR Names a one-dimensional integer string array which is interrogated for carries. It must be defined in a DIMENSION statement.

JBEG Integer constant, integer variable, or integer expression indicating the first digit in *JSTR* (beginning of substring).

JEND Integer constant, integer variable, or integer expression indicating the position of the last digit in *JSTR* (end of substring). *JEND* is greater than or equal to *JBEG*.

KOUT Identifies an integer variable used to hold any carry from the high order position of *JSTR* after execution of *SCARY*. If there is no carry, *KOUT* is set to zero.

Errors

None.

Comments

Generally, this routine is not called by the user since carries are resolved within the arithmetic routines SADD, SSUB, SMPY, and SDIV. SADD and SSUB call SCARY to resolve carries.

EXAMPLE

```
DIMENSION JDIGT(10)
M = 17
CALL CARRY(JDIGT,1,10,M)
```

Before

JDIGT =

Word	1		2		3		4		5		6		7		8		9		10	
Data	0	0	72	6	$2\overline{7}$	5	1	$\overline{8}$	1	1	△	△	△	△	△	△	△	△	△	△
String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

M = 17

After

JDIGT =

Word	1		2		3		4		5		6		7		8		9		10	
Data	0	7	2	3	3	5	0	2	1	1	△	△	△	△	△	△	△	△	△	△
String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

M = 0

As a result of multiple arithmetic operations, JDIGT originally has

As a result of multiple arithmetic operations, JDIGT originally has positions 3,5, and 8 as shown before execution of SCARY. Following execution of SCARY, a 1 has been borrowed from the 7th position to resolve the -8 condition, a 3 was borrowed from the 4th position to resolve the condition at position 5, and the 7 from 72 is now in position 2.

SDCAR

SUBSTRING D1 DECIMAL CARRY

SDCAR examines a specified D1 decimal substring for carries, resolves the carries in the next higher substring, and saves any carry from the high order digit of the substring.

NOTE: This routine normally is not called by a user.

Format

CALL SDCAR (JSTR, JBEG, JEND, KOUT)

JSTR Names a one-dimensional integer string array in D1 decimal format (one digit per word) which is interrogated for carries. It must be defined in a DIMENSION statement.

JBEG An integer constant, integer variable, or integer expression indicating the word position of the first digit to be carried in *JSTR* (beginning of substring).

JEND An integer constant, integer variable, or integer expression indicating the word position of the last digit to be carried in *JSTR* (end of substring). *JEND* is greater than or equal to *JBEG.*

KOUT Identifies an integer variable used to hold any carry from the high order position of *JSTR* after execution of SDCAR. If there is no carry, *KOUT* is set to zero.

Errors

None.

Comments

Generally, this routine is not called by the user since carries are resolved within the arithmetic routines SADD, SSUB, SMPY, and SDIV, SMPY and SDIV call SDCAR to resolve carries in D1 format substrings.

EXAMPLE

```
DIMENSION JDIGT(10)
M = 17
CALL SDCAR JDIGT(0,9,M)
```

Before

JDIGT =

Word	0	1	2	3	4	5	6	7	8	9
Data	0	0	72	6	$2\bar{7}$	5	1	$\bar{8}$	1	1
String	1 2	3 4	5 6	7 8	9 10	11 12	13 14	15 16	17 18	19 20

M = 17

After

JDIGT =

Word	0	1	2	3	4	5	6	7	8	9
Data	0	7	2	3	3	5	0	2	1	1
String	1 2	3 4	5 6	7 8	9 10	11 12	13 14	15 16	17 18	19 20

M = 0 (zero)

SDEA2

SUBSTRING DECIMAL TO A2 FORMAT

SDEA2 converts a substring from D2 format to A2 format.

NOTE: This routine normally is not called by user. It is used by the variable-length decimal string arithmetic subroutines: SADD, SSUB, SMPY and SDIV.

Format

CALL SDEA2 (JSTR, JBEG, JEND, IERR)

JSTR Names a one-dimensional integer string array containing the substring to be converted; it must be in decimal format, two digits per word before conversion. The array must be defined in a DIMENSION statement.

JBEG Integer constant, integer variable, or integer expression defining the position of the first digit of *JSTR* to be converted (beginning of substring).

JEND Integer constant, integer variable, or integer expression defining the position of the last digit in *JSTR* to be converted (end of substring). It must be greater than or equal to *JBEG.*

IERR An integer variable used as an error indicator. It is set when a digit is greater than nine or is negative unless the negative digit is at position *JEND* which, as the sign digit, can be negative.

Errors

The error indicator IERR is set equal to the position of the last invalid digit encountered. An invalid digit is one outside the range 0-9 except for a signed digit in the last position.

Comments

Only the last invalid digit is indicated by the error indicator. Other invalid digits may have been encountered to the left of the digit noted.

Errors should not occur since the arithmetic routines (SADD, SDIV, SMPY, and SSUB) resolve carries. If they do occur, the user's program should indicate it.

The user is responsible for setting, testing, and resetting the error indicator.

EXAMPLE

```
DIMENSION INFL (10)
IE = 0
CALL SDEA2 (INFL,7,17,IE)
```

Before

	Word	1		2		3		4		5		6		7		8		9		10	
INFL	*Data*	A	B	C	D	E	F	0	0	0	0	0	1	2	3	4	5	-1	E	N	D
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Decimal Format

IE = 0 (zero)

After

	Word	1		2		3		4		5		6		7		8		9		10	
INFL	*Data*	A	B	C	D	E	F	0	0	0	0	0	1	2	3	4	5	J	E	N	D
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

ASCII Format

IE = 0 (zero)

SD1D2

SUBSTRING DECIMAL D1 FORMAT TO SUBSTRING DECIMAL D2 FORMAT

SD1D2 converts a substring from D1 format (1 digit per word) to D2 format (2 digits per word).

NOTE: This routine normally is not called by the user. It is used by the variable-length decimal string arithmetic subroutines SMPY and SDIV.

Format

CALL SD1D2 (JSTR, JBEG, JEND, DIFF)

JSTR Names a one-dimensional integer string array containing the substring to be converted; it must be in D1 format, 1 digit per word before conversion. The array must be defined in a DIMENSION statement.

JBEG Integer constant, integer variable, or integer expression defining the first position of *JSTR* after conversion to D2 format.

JEND Integer constant, integer variable, or integer expression defining the last position of *JSTR* after conversion to D2 format. It must be greater than or equal to *JBEG*.

DIFF Integer constant, integer variable, or integer expression defining the bias to be added to any index or position pointer for D2 format to obtain an index for D1 format. It is calculated by SD2D1.

Errors

None.

EXAMPLE

```
DIMENSION INFL(10)
DIFF = -11
CALL SD1D2(JSTR,12,19,DIFF)
```

Before

	Word	1		2		3		4		5		6		7		8		9		10	
INFL	*Data*	A	B	0		1		2		3		4		5		6		7		7	H
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

D1 Format

DIFF = -11

After

	Word	1		2		3		4		5		6		7		8		9		10	
INFL	*Data*	A	B	0	0	0	0	0	0	0	0	0	0	1	2	3	4	5	6	7	H
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

D2 Format

DIFF unchanged

SD2D1

SUBSTRING DECIMAL D2 FORMAT TO SUBSTRING DECIMAL D1 FORMAT

SD2D1 converts a substring form D2 format (2 digits per word) to D1 format (1 digit per word).

NOTE: This routine normally is not called by the user. It is used by the variable-length decimal string arithmetic subroutines SMPY and SDIV to accommodate large numbers.

Format

CALL SD2D1 (JSTR, JBEG, JEND, DIFF)

JSTR Names a one-dimensional integer string array containing the substring to be converted; it must be in D2 decimal format, two digits per word before conversion. The array must be defined in a DIMENSION statement.

JBEG Integer constant, integer variable, or integer expression defining the position of the first digit of *JSTR* to be converted (beginning of substring).

JEND Integer constant, integer variable, or integer expression defining the position of the last digit in *JSTR* to be converted (end of substring). It must be greater than or equal to *JBEG*.

DIFF Integer constant, integer variable, or integer expression defining the bias to be added to any index or position pointer for D2 format to obtain an index for D1 format. It is calculated according to the formula

DIFF = -((JEND+1)/2+1)

Comments

Note that 2(JEND-JBEG+1) positions in JSTR must be available, so that no digit would ever be moved to a position preceding JSTR(1).

Errors

None.

EXAMPLE

```
DIMENSION INFL(10)
CALL SD2D1 (JSTR,12,19,DIFF)
```

Before

	Word	1		2		3		4		5		6		7		8		9		10	
INFL	*Data*	A	B	C	D	E	F	G	H	I	J	K	0	1	2	3	4	5	6	7	H
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

D2 Format

After

	Word	1		2		3		4		5		6		7		8		9		10	
INFL	*Data*	A	B	0	0	0	1	0	2	0	3	0	4	0	5	0	6	0	7	7	H
	String	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

D1 Format

DIFF = -11

SSIGN

SUBSTRING SIGN

SSIGN finds the sign of a number, sets a code to indicate this sign and gives the number a new sign (as specified).

NOTE: This routine normally is not called by a user. It is used by the variable-length decimal string arithmetic subroutines: SADD, SSUB, SMPY, SDIV, JSCOM.

Format

CALL SSIGN (JSTR, JBEG, NEWS, NOLDS)

JSTR Names a one-dimensional string integer array containing the character whose sign is to be tested and modified. The array must be defined in a DIMENSION statement. The character must be decimal format, two digits per word (D2).

JBEG Integer constant, integer variable, or integer expression defining the position of the character to be tested and modified.

NEWS Integer constant, integer variable, or integer expression containing the code for the new sign.

NOLDS Integer variable which is set to a code specifying the old (original) sign of the character.

Method

First the sign of the character at JBEG is retrieved and NOLDS is set as follows:

NOLDS	Original Sign
+1	non-negative
-1	Negative

Next, the character is given a new sign according to the code specified by NEWS. The table below shows the sign depending on the value of NEWS:

NEWS	New Sign
+1	positive
0	opposite of original sign
-1	negative
NOLDS	original sign retained

Errors

None.

Comments

The character to be processed must be in decimal format, two digits per word (D2 format), or the result is meaningless.

EXAMPLE

```
DIMENSION IDGT(10)
CALL SSIGN (IDGT,20,+1,NS)
```

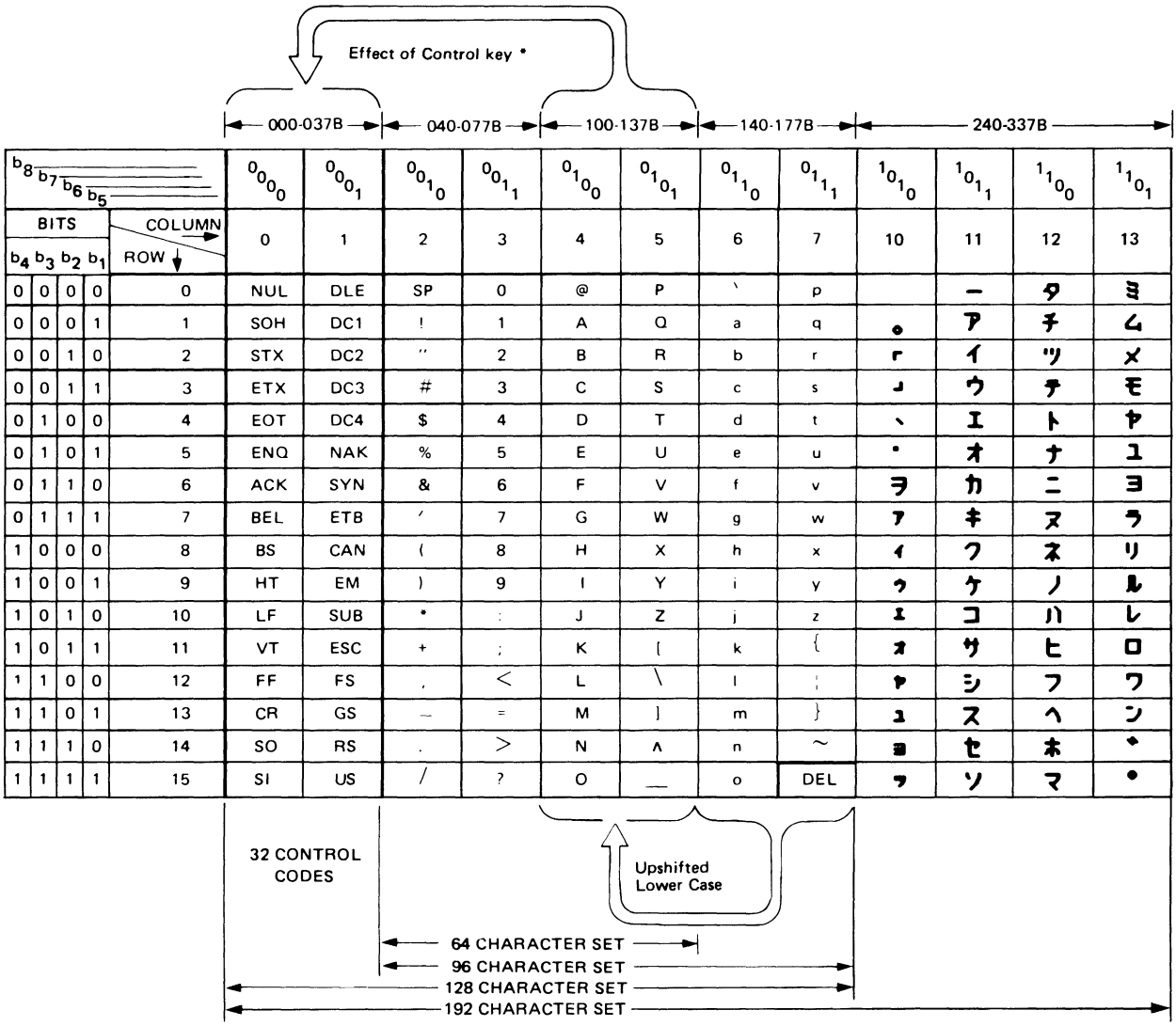
Before

```
IDGT(20) = +8
NS = 0
```

After

```
IDGT(20) - +8 (no change)
NS = +1
```

APPENDIX A
HP CHARACTER SET FOR COMPUTER SYSTEMS



$b_8 b_7 b_6 b_5$					$0\,0\,0_0$	$0\,0\,0_1$	$0\,0\,1_0$	$0\,0\,1_1$	$0\,1\,0_0$	$0\,1\,0_1$	$0\,1\,1_0$	$0\,1\,1_1$	$1\,0\,1_0$	$1\,0\,1_1$	$1\,1\,0_0$	$1\,1\,0_1$
BITS				COLUMN → / ROW ↓	0	1	2	3	4	5	6	7	10	11	12	13
b_4	b_3	b_2	b_1													
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p		ー	タ	ミ
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q	。	ア	チ	ム
0	0	1	0	2	STX	DC2	"	2	B	R	b	r	「	イ	ツ	メ
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s	」	ウ	テ	モ
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t	、	エ	ト	ヤ
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u	・	オ	ナ	ユ
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v	ヲ	カ	ニ	ヨ
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w	ァ	キ	ヌ	ラ
1	0	0	0	8	BS	CAN	(	8	H	X	h	x	ィ	ク	ネ	リ
1	0	0	1	9	HT	EM	)	9	I	Y	i	y	ゥ	ケ	ノ	ル
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z	ェ	コ	ハ	レ
1	0	1	1	11	VT	ESC	+	;	K	[	k	{	ォ	サ	ヒ	ロ
1	1	0	0	12	FF	FS	,	<	L	\	l	¦	ャ	シ	フ	ワ
1	1	0	1	13	CR	GS	–	=	M	]	m	}	ュ	ス	ヘ	ン
1	1	1	0	14	SO	RS	.	>	N	^	n	~	ョ	セ	ホ	゛
1	1	1	1	15	SI	US	/	?	O	_	o	DEL	ッ	ソ	マ	゜

EXAMPLE: The representation for the character "K" (column 4, row 11) is.

$b_8\ b_7\ b_6\ b_5\ b_4\ b_3\ b_2\ b_1$

BINARY 0 1 0 0 1 0 1 1

OCTAL 1 1 3

* Depressing the Control key while typing an upper case letter produces the corresponding control code on most terminals. For example, Control-H is a backspace.

9206-1B

HEWLETT-PACKARD CHARACTER SET FOR COMPUTER SYSTEMS

This table shows HP's implementation of ANS X3.4-1968 (USASCII) and ANS X3.32-1973. Some devices may substitute alternate characters from those shown in this chart (for example, Line Drawing Set or Scandanavian font). Consult the manual for your device.

The left and right byte columns show the octal patterns in a 16 bit word when the character occupies bits 8 to 14 (left byte) or 0 to 6 (right byte) and the rest of the bits are zero. To find the pattern of two characters in the same word, add the two values. For example, "AB" produces the octal pattern 040502. (The parity bits are zero in this chart.)

The octal values 0 through 37 and 177 are control codes. The octal values 40 through 176 are character codes.

Decimal Value	Octal Values		Mnemonic	Graphic[1]	Meaning
	Left Byte	Right Byte			
0	000000	000000	NUL	$^{N}_{U}$	Null
1	000400	000001	SOH	$^{S}_{H}$	Start of Heading
2	001000	000002	STX	$^{S}_{X}$	Start of Text
3	001400	000003	ETX	$^{E}_{X}$	End of Text
4	002000	000004	EOT	$^{E}_{T}$	End of Transmission
5	002400	000005	ENQ	$^{E}_{Q}$	Enquiry
6	003000	000006	ACK	$^{A}_{K}$	Acknowledge
7	003400	000007	BEL		Bell, Attention Signal
8	004000	000010	BS	$^{B}_{S}$	Backspace
9	004400	000011	HT	$^{H}_{T}$	Horizontal Tabulation
10	005000	000012	LF	$^{L}_{F}$	Line Feed
11	005400	000013	VT	$^{V}_{T}$	Vertical Tabulation
12	006000	000014	FF	$^{F}_{F}$	Form Feed
13	006400	000015	CR	$^{C}_{R}$	Carriage Return
14	007000	000016	SO	$^{S}_{O}$	Shift Out } Alternate
15	007400	000017	SI	$^{S}_{I}$	Shift In } Character Set
16	010000	000020	DLE	$^{D}_{L}$	Data Link Escape
17	010400	000021	DC1	D_1	Device Control 1 (X-ON)
18	011000	000022	DC2	D_2	Device Control 2 (TAPE)
19	011400	000023	DC3	D_3	Device Control 3 (X-OFF)
20	012000	000024	DC4	D_4	Device Control 4 ($\overline{\text{TAPE}}$)
21	012400	000025	NAK	$^{N}_{K}$	Negative Acknowledge
22	013000	000026	SYN	$^{S}_{Y}$	Synchronous Idle
23	013400	000027	ETB	$^{E}_{B}$	End of Transmission Block
24	014000	000030	CAN	$^{C}_{N}$	Cancel
25	014400	000031	EM	$^{E}_{M}$	End of Medium
26	015000	000032	SUB	$^{S}_{B}$	Substitute
27	015400	000033	ESC	$^{E}_{C}$	Escape[2]
28	016000	000034	FS	$^{F}_{S}$	File Separator
29	016400	000035	GS	$^{G}_{S}$	Group Separator
30	017000	000036	RS	$^{R}_{S}$	Record Separator
31	017400	000037	US	$^{U}_{S}$	Unit Separator
127	077400	000177	DEL	▩	Delete, Rubout[3]

Decimal Value	Octal Values		Character	Meaning
	Left Byte	Right Byte		
32	020000	000040		Space, Blank
33	020400	000041	!	Exclamation Point
34	021000	000042	"	Quotation Mark
35	021400	000043	#	Number Sign, Pound Sign
36	022000	000044	$	Dollar Sign
37	022400	000045	%	Percent
38	023000	000046	&	Ampersand, And Sign
39	023400	000047	'	Apostrophe, Acute Accent
40	024000	000050	(	Left (opening) Parenthesis
41	024400	000051	)	Right (closing) Parenthesis
42	025000	000052	*	Asterisk, Star
43	025400	000053	+	Plus
44	026000	000054	,	Comma, Cedilla
45	026400	000055	-	Hyphen, Minus, Dash
46	027000	000056	.	Period, Decimal Point
47	027400	000057	/	Slash, Slant
48	030000	000060	0	Digits, Numbers
49	030400	000061	1	
50	031000	000062	2	
51	031400	000063	3	
52	032000	000064	4	
53	032400	000065	5	
54	033000	000066	6	
55	033400	000067	7	
56	034000	000070	8	
57	034400	000071	9	
58	035000	000072	:	Colon
59	035400	000073	;	Semicolon
60	036000	000074	<	Less Than
61	036400	000075	=	Equals
62	037000	000076	>	Greater Than
63	037400	000077	?	Question Mark

Decimal Value	Octal Values		Character	Meaning
	Left Byte	Right Byte		
64	040000	000100	@	Commercial At
65	040400	000101	A	
66	041000	000102	B	
67	041400	000103	C	
68	042000	000104	D	
69	042400	000105	E	
70	043000	000106	F	
71	043400	000107	G	
72	044000	000110	H	
73	044400	000111	I	
74	045000	000112	J	
75	045400	000113	K	
76	046000	000114	L	
77	046400	000115	M	
78	047000	000116	N	Upper Case Alphabet, Capital Letters
79	047400	000117	O	
80	050000	000120	P	
81	050400	000121	Q	
82	051000	000122	R	
83	051400	000123	S	
84	052000	000124	T	
85	052400	000125	U	
86	053000	000126	V	
87	053400	000127	W	
88	054000	000130	X	
89	054400	000131	Y	
90	055000	000132	Z	
91	055400	000133	[	Left (opening) Bracket
92	056000	000134	\	Backslash, Reverse Slant
93	056400	000135	]	Right (closing) Bracket
94	057000	000136	^ ↑	Caret, Circumflex; Up Arrow[4]
95	057400	000137	_ ←	Underline; Back Arrow[4]

Decimal Value	Octal Values		Character	Meaning
	Left Byte	Right Byte		
96	060000	000140	`	Grave Accent[5]
97	060400	000141	a	
98	061000	000142	b	
99	061400	000143	c	
100	062000	000144	d	
101	062400	000145	e	
102	063000	000146	f	
103	063400	000147	g	
104	064000	000150	h	
105	064400	000151	i	
106	065000	000152	j	
107	065400	000153	k	
108	066000	000154	l	
109	066400	000155	m	
110	067000	000156	n	Lower Case Letters[5]
111	067400	000157	o	
112	070000	000160	p	
113	070400	000161	q	
114	071000	000162	r	
115	071400	000163	s	
116	072000	000164	t	
117	072400	000165	u	
118	073000	000166	v	
119	073400	000167	w	
120	074000	000170	x	
121	074400	000171	y	
122	075000	000172	z	
123	075400	000173	{	Left (opening) Brace[5]
124	076000	000174	¦	Vertical Line[5]
125	076400	000175	}	Right (closing) Brace[5]
126	077000	000176	~	Tilde, Overline[5]

9206-1C

Notes:
[1]This is the standard display representation. The software and hardware in your system determine if the control code is displayed, executed, or ignored. Some devices display all control codes as "||", "@", or space.

[2]Escape is the first character of a special control sequence. For example, ESC followed by "J" clears the display on a 2640 terminal.

[3]Delete may be displayed as "__", "@", or space.

[4]Normally, the caret and underline are displayed. Some devices substitute the up arrow and back arrow.

[5]Some devices upshift lower case letters and symbols (` through ~) to the corresponding upper case character (@ through ^). For example, the left brace would be converted to a left bracket.

Decimal Value	Octal Values		Character	Meaning
	Left Byte	Right Byte		
161	120400	000241	｡	Japanese Katakana Character Set
162	121000	000242	｢	
163	121400	000243	｣	
164	122000	000244	､	
165	122400	000245	･	
166	123000	000246	ｦ	
167	123400	000247	ｧ	
168	124000	000250	ｨ	
169	124400	000251	ｩ	
170	125000	000252	ｪ	
171	125400	000253	ｫ	
172	126000	000254	ｬ	
173	126400	000255	ｭ	
174	127000	000256	ｮ	
175	127400	000257	ｯ	
176	130000	000260	ｰ	
177	130400	000261	ｱ	
178	131000	000262	ｲ	
179	131400	000263	ｳ	
180	132000	000264	ｴ	
181	132400	000265	ｵ	
182	133000	000266	ｶ	
183	133400	000267	ｷ	
184	134000	000270	ｸ	
185	134400	000271	ｹ	
186	135000	000272	ｺ	
187	135400	000273	ｻ	
188	136000	000274	ｼ	
189	136400	000275	ｽ	
190	137000	000276	ｾ	
191	137400	000277	ｿ	

Decimal Value	Octal Values		Character	Meaning
	Left Byte	Right Byte		
192	140000	000300	ﾀ	Japanese Katakana Character Set
193	140400	000301	ﾁ	
194	141000	000302	ﾂ	
195	141400	000303	ﾃ	
196	142000	000304	ﾄ	
197	142400	000305	ﾅ	
198	143000	000306	ﾆ	
199	143400	000307	ﾇ	
200	144000	000310	ﾈ	
201	144400	000311	ﾉ	
202	145000	000312	ﾊ	
203	145400	000313	ﾋ	
204	146000	000314	ﾌ	
205	146400	000315	ﾍ	
206	147000	000316	ﾎ	
207	147400	000317	ﾏ	
208	150000	000320	ﾐ	
209	150400	000321	ﾑ	
210	151000	000322	ﾒ	
211	151400	000323	ﾓ	
212	152000	000324	ﾔ	
213	152400	000325	ﾕ	
214	153000	000326	ﾖ	
215	153400	000327	ﾗ	
216	154000	000330	ﾘ	
217	154400	000331	ﾙ	
218	155000	000332	ﾚ	
219	155400	000333	ﾛ	
220	156000	000334	ﾜ	
221	156400	000335	ﾝ	
222	157000	000336	ﾞ	
223	157400	000337	ﾟ	

APPENDIX B
BASIC CALLABLE ROUTINES

SADD

SUBSTRING DECIMAL ADD

SADD adds two character substrings of arbitrary length and stores the result in the second substring.

Format

CALL SADD (J$, K$, E)

CALL Optional.

J$ A string or string variable containing the first character substring to be added.

K$* A string or string variable containing the substring to which the substring in *J$ is to be added. It will contain the result following the addition.

E An integer variable used as an error indicator. The value of *E* following execution of *SADD* indicates whether arithmetic overflow occurred. Upon normal completion, *E* is set equal to 0 (zero).

Errors

- If there was arithmetic overflow (K$ is not large enough to contain the sum), E is set equal to the length of K$ and the K$ field is filled with 9's.
- If J$ is longer than K$, E is set equal to the length of K$.
- If either J$ or K$ do not contain all ASCII numeric characters (except for the rightmost character), E is set equal to -1.

Comments

J$ and K$ can be any length up to the maximum 255 characters. J$, however, must not be greater than K$ or an overflow condition will result.

The characters in J$ and K$ must all be ASCII numeric, 0-9, except the rightmost character which may be an 11-zone character, indicating a negative number.

At the conclusion of SADD, the rightmost character in K$ carries the sign of the sum. Thus, if the sum is negative, the rightmost character will be an 11-zone character. However, if the sum is zero, the rightmost character may be eight 0 (zero) or - (minus sign).

EXAMPLE

```
DIMJ$ (12), K$ (18)
J$="037141002416"
K$="015346789350009876"
SADD (J$, K$, E)
```

Before

J$ =

string	1	2	3	4	5	6	7	8	9	10	11	12
data	0	3	7	1	4	1	0	0	2	4	1	6

K$ =

string	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
data	0	1	5	3	4	6	7	8	9	3	5	0	0	0	9	8	7	6

After

J$ = No change

K$ =	string	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	data	0	1	5	3	4	6	8	2	6	4	9	1	0	1	2	2	9	2

E = 0 (zero)

The data field J$ is added to K$ and the result placed in K$. The error indicator is set equal to zero since no overflow occurred.

SSUB

SUBSTRING DECIMAL SUBTRACT

SSUB subtracts one substring from a second substring and places the result in the second substring. Both substrings may be of any length.

Format

CALL SSUB (J$, K$, E)

CALL Optional.

J$ A string or string variable containing the substring that is to be subtracted from a second substring.

K$* A string or string variable containing the substring from which the substring in *J$ is to be subtracted. *K$* will contain the result following the subtraction.

E An integer variable used as an error indicator. Upon normal completion, *E* is set equal to zero.

Errors

- If there was arithmetic overflow (K$ was not large enough to contain the result), E is set equal to the length of K$ and K$ is filled with 9's.
- If J$ is longer than K$, E is set equal to the length of K$.
- If either J$ or K$ does not contain all ASCII numeric characters (except for the right-most character), E is set equal to -1.

Comments

See comments for SADD.

EXAMPLE

DIM J$ (8) , K$ (16)

J$="15643055"

K$="0000723579834050"

SSUB (J$, K$, E)

Before

J$ =

string	1	2	3	4	5	6	7	8
data	1	5	6	4	3	0	5	5

K$ =

string	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
data	0	0	0	0	7	2	3	5	7	9	8	3	4	0	5	0

After

J$ = No change

K$ =

string	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
data	0	0	0	0	7	2	3	5	6	4	1	9	0	9	9	5

E = 0 (zero)

The decimal data field J$ is subtracted from the decimal data field K$ and the result placed in K$. Since J$ is positive, it is made negative and then added to K$ producing the result. The error indicator is set to zero since no overflow occurred.

SMPY

SUBSTRING DECIMAL MULTIPLY

SMPY multiplies two character data substrings and places the result in the second substring.

Format

CALL SMPY (J$, K$, E)

CALL Optional.

J$ A string or string variable containing the multiplier.

K$* A string or string variable containing the multiplicand. After the multiplication, *K$ will contain the product extended to the left.

E An integer variable used as an error indicator. Upon normal completion, *E* is set equal to 0 (zero).

Errors

- If K$ does not have enough positions to allow for its extension to the left in order to receive the product, E is set equal to the length of K$.
- If J$ or K$ does not contain all ASCII numeric characters (except the rightmost character), E is set equal to -1.

Comments

The data is converted from ASCII to numeric within SMPY. J$ and K$ can be any length up to the maximum 255 characters. Sufficient space must be allocated to K$ to allow for its extension. At least J positions must be provided between the beginning of K$ and the first multiplicand position, where J is the length of J$. That is, if J$ has five positions and the multiplicand has 7 positions, K$ must be dimensioned to be at least 12 positions long.

The SMPY arithmetic is decimal arithmetic using whole numbers only.

The product of SMPY is located in K$.

EXAMPLE

DIM J$ (4), K$ (10)

J$="1540"

K$="865832"

SMPY (J$, K$, E)

Before

J$ =

string	1	2	3	4
data	1	5	4	0

K$ =

string	1	2	3	4	5	6	7	8	9	10
data	8	6	5	8	3	2				

After

J$ = No change

K$ =										
string	1	2	3	4	5	6	7	8	9	10
data	1	3	3	3	3	8	1	2	8	0

E = 0 (zero)

The numeric data fields J$ and K$ are multiplied and the result placed in K$. The field has been extended to the left 4 positions. E is set equal to zero since no overflow occurred.

SDIV

SUBSTRING DECIMAL DIVISION

SDIV divides arbitrary length substring K$ by another substring J$, placing the quotient and the remainder in K$.

Format

CALL SDIV (J$, K$, E, R)

CALL Optional.

J$ A string or string variable containing the divisor.

*K$* A string or string variable containing the dividend. After the division, K$ will contain the quotient and the remainder, extended to the left.

E An integer variable used as an error indicator. Upon normal completion, *E* is set equal to 0 (zero).

R An integer variable used to indicate the position in the result string *K$* where the remainder begins.

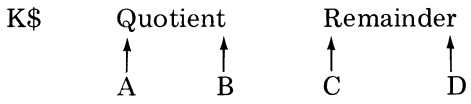
Errors

- If division by zero was attempted, E is set equal to the length of K$.
- If insufficient space is allocated to K$ for the quotient and remainder, E is set equal to the length of K$.
- If the length of the divisor is greater than the length of the dividend, E is set equal to the length of K$.
- If J$ or K$ does not contain all ASCII numeric characters (except the rightmost character), E is set equal to -1.

Comments

J$ and K$ can be any length up to the maximum 255 characters. Sufficient space must be allocated to K$ to allow for its extension. At least J positions must be provided between the beginning of K$ and the first dividend position, where J is the length of J$. For instance, if J$ has 5 positions and K$ has 7 positions, then K$ must be dimensioned to be at least 12 positions long.

The quotient and the remainder will both be located in the extended K$ field according to the diagram below:



A is the position:	beginning of K$
B is the position:	end of K$ - length of J$
C is the position:	end of K$ - length of J$ +1
D is the position:	end of K$

The SDIV arithmetic is decimal arithmetic using whole numbers only, with no decimal point alignment. Therefore, the numbers should have an assumed decimal point following the rightmost digit.

EXAMPLE

Divide 7943074 by -43135

DIM J$ (5), K$ (12)

J$= "4213N"

K$= "7943074"

SDIV (J$, K$, E, R)

Before

J$ =

string	1	2	3	4	5
data	4	2	1	3	N

NOTE: 11-zone 5 (N)

K$ =

string	1	2	3	4	5	6	7	8	9	10	11	12
data	7	9	4	3	0	7	4					

After

J$ = No change

K$ =												
string	1	2	3	4	5	6	7	8	9	10	11	12
data	0	0	0	0	1	8	Q	2	1	6	9	4

*- - - - Quotient - - - - * * - - Remainder - *

E = 0 (zero)

R = 8

The numeric field K$ was divided by the numeric field J$ with the quotient and remainder placed in K$. The field has been extended 5 places to the left and filled with zeros. The remainder is in the 5 low order positions of K$, the quotient in positions 1 thorough 7.

SEDIT

SEDIT edits data in one substring using an edit mask in a second substring, placing the edited data in the second substring.

Format

CALL SEDIT (J$, K$, E)

CALL Optional.

J$ A string or string variable containing the data to be edited.

*K$* A string or string variable containing the edit mask. K$ will contain the edited result.

E An integer variable set to the length of K$ if J$ is longer than K$ (no editing is done). Upon normal completion, E is set equal to 0 (zero).

Alphanumeric Editing

X(ALPHANUMERIC REPLACEMENT HOLDER). Alphanumeric edit masks are used to edit character substrings and consist of X's as replacement holders and any other character as insertions characters. Characters are placed in the edit mask from right to left. Each replacement holder (X) in the edit mask is replaced in the display result with a character from the substring. Each insertion character (anything other than X) in the edit mask appears unmodified in the display result. If the end of the mask is reached before the end of the character substring, the remaining characters in the elements are not displayed. If the end of the character substring is reached before the end of the mask, the remainder of the display is replaced by asterisks. The character substring must be defined as ASCII if using the alphanumeric edit mask.

EXAMPLES

Character Substring	*Edit Mask*	*Edited Result*
MNRZ	*"X-XX-X"*	*M-NR-Z*
MNRZ	*"XXX"*	*NRZ*
MNRZ	*"XX/XX/XX"*	***/MN/RZ*

Numeric Editing

Numeric edit masks are used to edit ASCII numeric, 0-9. Numeric edit masks consist of replacement holders, sign characters, and insertion characters.

Replacement

9 (NUMERIC REPLACEMENT HOLDER). Each 9 in the edit mask is replaced by a decimal digit in the corresponding position of the numeric substring.

Z (ZERO SUPPRESSION REPLACEMENT HOLDER). The position of the Z in the edit mask is replaced by a decimal digit in the corresponding position of the numeric substring. Zeros to the left of the first significant position in the substring are replaced by blanks.

*** (ASTERISK REPLACEMENT HOLDER).** Asterisks rather than blanks are inserted to the left of the first significant decimal digit in the substring.

$ (DOLLAR SIGN REPLACEMENT HOLDER). A dollar sign is inserted to the left of the first significant digit in the substring, and is to the left of the position that defined the zero suppression. Any zero in the remaining non-significant positions are replaced by blanks.

Sign Characters

CR (CREDIT). These two characters are placed in the rightmost positions of the edit mask. If the decimal substring is negative, the characters remain in the edited output. If the substring value is positive, CR is replaced by two blanks. When CR is present in the edit mask, no data is edited into the last two positions but only into the edit characters to the left.

- (MINUS). This character placed in the rightmost position of the edit mask is treated similarly to CR. It remains if the substring value is negative; is replaced by a blank when the substring value is positive. A minus elsewhere in the edit mask remains in that position in the edited output.

Insertion Characters

All other characters in the edit mask not defined above are insertion characters.

Operations of SEDIT

The characters are placed in the edit mask from right to left. Only the characters 9, X, *, and $ are replaced by decimal characters in the substring.

If the characters CR or a minus are in the rightmost position or positions, they are made blank for a positive substring value and left unchanged for a negative substring value.

Zero suppression proceeds from left to right of the edit mask. Any of the edit mask characters: 9, Z, X, . (decimal point), or , (comma) is replaced by a blank unless the zero suppression character is an asterisk in which case it is replaced by an asterisk.

Rules Governing Creation of Edit Mask

There must be no more than one decimal point. Zero suppression is used when the edit mask contains a Z (zero), * (asterisk), or $ (dollar sign) and:

1. A Z may not appear anywhere after a 9, *, or $ which is not the first holder in the edit mask.

2. A * may not appear anywhere after a 9, Z, or $ which is not the first holder in the edit mask.

3. A $ may not appear anywhere after a Z, 9, or *.

In editing a numeric data substring through a numeric edit mask, the digits which represent the value of the substring are exchanged for the replacement holder. The decimal point remains in the edited output where it was placed in the edit mask. If, however, zero suppression is also requested, it is replaced by a blank if it is to the left of the last character to be suppressed.

Any insertion character appears unmodified in the display unless it is a decimal point or comma with zero suppression.

EXAMPLES

Substring Value	*Edit Mask*	*Edited Result*
0059	*"$$$,999"*	*$059*
1024	*"ZZZ,ZZZ"*	*1,024*
010555	*"$$,$$$.99CR"*	*$105.55*
-010555	*"$$,$$$,99CR"*	*$105.55CR*
-010555	*"$$,$$$.99-"*	*$105.55-*
010555	*"$$,$$$.99-"*	*$105.55*
15039250	*"$,$$$,$$$.99CR"*	*$150,392.50*
-1399	*"*,***.99CR"*	****13.99CR*
044240474	*"999-99-9999"*	*044-24-0474*
-2145	*"$,$$$.99"*	*$21.45*
24	*"999.99"*	*000.24*
24	*"9.99.9"*	****0.24*
1234	*"X.XX.X"*	*1.23.4*

BASIC SUBROUTINE TABLE GENERATION

In order to call external subroutines from BASIC, the RTE Table Generator (RTETG) must be used to define and generate the Branch and Mnemonic Tables and create overlays which contain the actual subroutines. BASIC uses the Branch and Mnemonic Tables to transfer program execution from BASIC to the subroutine and back. The user provides RTETG with a command file defining each subroutine to be called. The following command format is used:

$$\text{name [(p1,p2,...,pn)],OV=nn} \left[\begin{matrix}\text{,BP}\\\text{,BT}\\\text{,FP}\\\text{,FT}\end{matrix}\right]\text{[,SZ=mm]} \left[\begin{matrix}\text{,INTG}\\\text{,REAL}\end{matrix}\right]\text{[,ENT=p] [,FIL=f]}$$

where:

name
is the name of the subroutine.

p1, p2,...,pn
are descriptions of the parameter types.

nn
is an integer representing the overlay number.

mm
is an integer representing the overlay size in pages.

p
is the entry point name.

f
is the name of the file in which the subroutine is found.

Inclusion of Decimal String Arithmetic subroutines require the following RTETG commands:

```
SADD (RA,RVA,IV) ,   OV=nn,ENT=D.ADD,FIL=%BADEC
SSUB (RA,RVA,IV) ,   OV=nn,ENT=D.SUB,FIL=%BADEC
SMPY (RA,RVA,IV) ,   OV=nn,ENT=D.MPY,FIL=%BADEC
SDIV (RA,RVA,IV,IV) ,OV=nn,ENT=D.DIV,FIL=%BADEC
SEDIT (RA,RVA, IV) , OV=nn,ENT=D.EDT,FIL=%BADEC
```

For further information on subroutine table generation, the user is directed to the Multi-User Real-Time BASIC Reference Manual (92060-90016).

READER COMMENT SHEET

Decimal String Arithmetic Routines

02100-90140 Oct 1979

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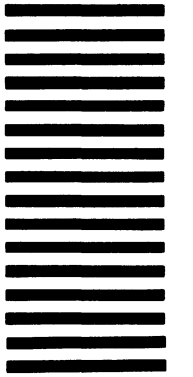

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MUSCAT
Tel: 722225, 745601
Telex: 3289 BROKER MB MUSCAT
P

SALES & SUPPORT OFFICES

Arranged Alphabetically by Country

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Tel: 734 201-3
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PAKISTAN

Mushko & Company Ltd.
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Sector F-8/1
ISLAMABAD
Tel: 26875
Cable: FEMUS Rawalpindi
A,E,M

Mushko & Company Ltd.
Oosman Chambers
Abdullah Haroon Road
KARACHI 0302
Tel: 511027, 512927
Telex: 2894 MUSKO PK
Cable: COOPERATOR Karachi
*A,E,M,P**

PANAMA

Electrónico Balboa, S.A.
Calle Samuel Lewis, Ed. Alfa
Apartado 4929
PANAMA 5
Tel: 64-2700
Telex: 3483 ELECTRON PG
A,CM,E,M,P
Foto Internacional, S.A.
Colon Free Zone
Apartado 2068
COLON 3
Tel: 45-2333
Telex: 8626 IMPORT PG
P

PERU

Cía Electro Médica S.A.
Los Flamencos 145, San Isidro
Casilla 1030
LIMA 1
Tel: 41-4325, 41-3703
Telex: Pub. Booth 25306
A,CM,E,M,P

PHILIPPINES

The Online Advanced Systems Corporation
Rico House, Amorsolo Cor. Herrera Street
Legaspi Village, Makati
P.O. Box 1510
Metro ***MANILA***
Tel: 85-35-81, 85-34-91, 85-32-21
Telex: 3274 ONLINE
A,CH,CS,E,M
Electronic Specialists and Proponents Inc.
690-B Epifanio de los Santos Avenue
Cubao, ***QUEZON CITY***
P.O. Box 2649 Manila
Tel: 98-96-81, 98-96-82, 98-96-83
Telex: 40018, 42000 ITT GLOBE MACKAY BOOTH
P

PORTUGAL

Mundinter
Intercambio Mundial de Comércio S.a.r.l
P.O. Box 2761
Av. Antonio Augusto de Aguiar 138
P-LISBON
Tel: (19) 53-21-31, 53-21-37
Telex: 16691 munter p
M

Soquimica
Av. da Liberdade, 220-2
1298 ***LISBON*** *Codex*
Tel: 56 21 81/2/3
Telex: 13316 SABASA P
Telectra-Empresa Técnica de Equipmentos Eléctricos S.a.r.l.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
P-LISBON *1*
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RIO PIEDRAS, Puerto Rico 00924
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A,CH,CS

QATAR

Nasser Trading & Contracting
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DOHA
Tel: 22170, 23539
Telex: 4439 NASSER DH
M
Computearbia
P.O. Box 2750
DOHA
Tel: 883555
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P

Eastern Technical Services
P.O. Box 4747
DOHA
Tel: 329 993
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SAUDI ARABIA

Modern Electronic Establishment
Hewlett-Packard Division
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Telex: 671 106 HPMEEK SJ
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E

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C

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