BASIC Language Reference
(Section One)

IBM

System/23

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System/23

Second Edition (July 1981)

This is a major revision of, and obsoletes SA34-0109-0. The significant changes are to the Customer Support Functions. The three new Customer Support Functions are:

- List diskette
- List file
- List storage

Preface

About this book

This reference manual provides specific information about the System/23 BASIC language. It was prepared with the assumption that you wish to write or change BASIC programs. If you are not an experienced BASIC programmer, you should complete *Learning System/23 BASIC* before using this book. This book is a precise reference which will supplement *Learning System/23 BASIC*, but not replace it.

How to use this book

The information in this book is in encyclopedic format and presents topics in alphabetic order. To make it easy to use, this book uses cross-referencing that leads you to other topics which may be of interest to you. The cross-referencing takes the following form:

Dimensioning arrays see ''Declaring arrays''

This tells you that the information on dimensioning arrays can be found in the section titled ''Declaring arrays''.

Prerequisites

You should be experienced in programming the BASIC language or should have completed *Learning System/23 BASIC*.

Preface

Related publications

- *Operator Reference*, SA34-0108
- *Learning System/23 BASIC*
  - SA34-0121—Book I
  - SA34-0122—Book II
  - SA34-0123—Book III
  - SA34-0124—Book IV
  - SA34-0125—Book V
  - SA34-0126—Book VI
  - SA34-0127—Book VII
- *System Messages*, SA34-0141
- *5110 Conversion Aid Program User's Guide*, SA34-0114
- *Customer Support Functions, Volume 1*, SA34-0175 and *Volume II*, SA34-0176

Introduction

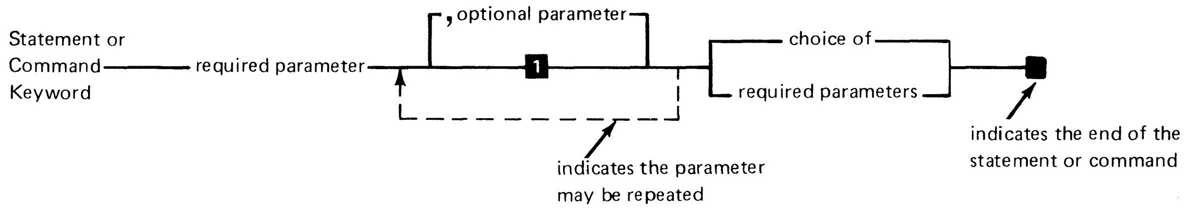
This book contains detailed descriptions of the system commands, statements, concepts, data constants, variables, and the BASIC syntax. This is a complete reference of the BASIC language as used in System/23 and was designed so that each topic can be found quickly. Each topic stands by itself and, as in an encyclopedia, the topics are in alphabetic order by topic name.

A comprehensive program is included in Appendix A in the back of this manual. It is suggested that this program be reviewed.

Syntax description

When syntax formats are described in this manual, capitalized expressions, lowercase expressions, and special characters (such as a comma, colon, exclamation point, or an asterisk) have special meaning.

Syntax of the BASIC commands and statements is presented in the following format:


Statement or Command Keyword
required parameter
, optional parameter
1
choice of
required parameters
indicates the parameter may be repeated
indicates the end of the statement or command

Where:

Statement or Command keyword is a BASIC statement such as LET or a command such as RUN.

required parameter is an item that must be included such as the line reference in GOTO 100.

optional parameter is an item that may be included if desired such as ELSE in an IF, THEN, ELSE statement.

indicates that the parameter may be repeated means that more than one parameter can be included such as the variables in INPUT A, B, C ...

choice of required parameters means that one of the parameters must be included such as the choice between numeric or character constants in a DATA statement.

indicates the end of the statement or command refers to the block that indicates the end of the syntax.

To read the syntax of a command or statement, read from left to right along the main line. When you reach an optional parameter, you can either include that parameter or continue along the main line. When you reach a choice of required parameters, you must include one of the parameters with your command or statement.

If a parameter is shown in uppercase letters, you must enter it exactly as it appears. You must also enter any special character (such as a comma or colon) that appears in the diagram.

All lines entered in BASIC program entry mode and command entry mode are converted to English uppercase prior to syntax checking.

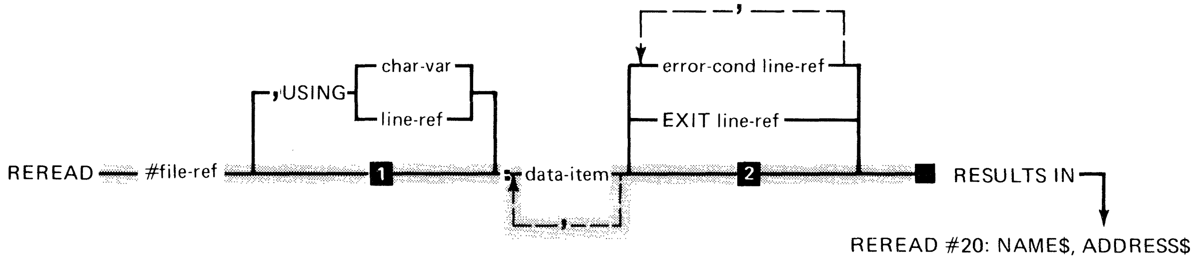
To prevent remarks or character data on DATA statements from being converted to English uppercase, they must be enclosed in quotation marks.

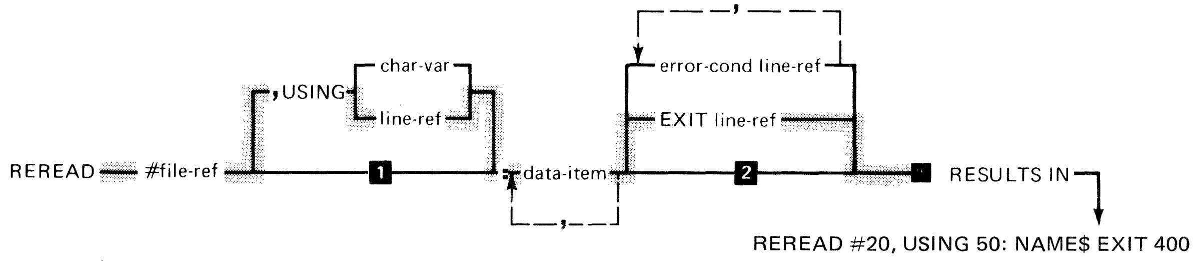
If you do not include an optional parameter, the System/23 provides a default value or action. The defaults are listed in the description of the statement or command. The syntax diagrams include a number (such as **1**) that corresponds to the defaults listed.

In the case of the MERGE, REPLACE, and VOLID commands *only*, you must include a comma to indicate that you have omitted an optional parameter.

Syntax description (continued)

Here are two examples using the REREAD statement:

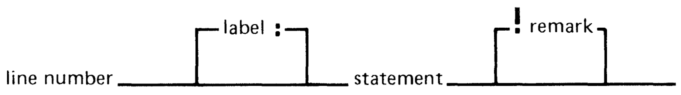




In these examples, you must include the *file-ref* parameter following the keyword REREAD. You may choose to include the USING parameter in which case you must also include either the *char-var* or *line-ref* parameter. You must include the colon, followed by at least one *data-item*. Note that you may list more than one *data-item*. You may choose to include either *EXIT line-ref* or *error-cond line-ref*.

In the first example, the optional parameters are omitted. Therefore the default actions are taken.

The syntax for a BASIC statement is as shown:



A keyword in a BASIC statement or system command must be followed by a blank except where a comma, parenthesis, or other appropriate delimiter is defined. Also a blank must follow the leading line number in a BASIC statement.

A label can be added to any BASIC statement except a DEF statement (see ''Labels'').

A remark can be added at the end of any system command or BASIC statement except a DATA statement (see ''Remarks'').

Because they can be used on most BASIC statements, labels and remarks are not shown in the diagrams that follow.

Absolute value

see "ABS(X)"

ABS(X)

Returns the absolute value of X. The result is always positive. For example:

```
10 X=-5.2
20 Y=ABS(X)
```

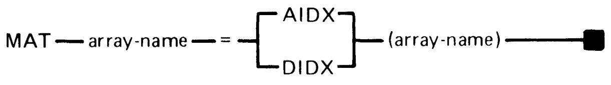
Y contains +5.2

```
10 X=+13.7
20 Y=ABS(X)
```

Y contains +13.7

AIDX and DIDX

The MAT assignment AIDX or DIDX statement creates an index to the elements of an array which will rearrange the original array with the elements in ascending or descending order. Character arrays are indexed alphabetically, and numeric arrays are indexed numerically.



The syntax of the statement is as shown above, where:

array-name is the name of a one-dimensional array.

AIDX indicates the ascending index function.

DIDX indicates the descending index function.

When a MAT AIDX or DIDX statement is executed, index values are assigned to the array on the left of the equal sign, according to the order of the values entered into the array on the right of the equal sign.

AIDX and DIDX (continued)

Example (AIDX)

```
20 OPTION BASE 1
30 DIM A(10), B(10)
40 MAT B=AIDX(A)
```

If array A is	9	array B will be	4 (position one)
	5		9
	6		5
	0 (position four)		10
	2		8
	7		2
	8		3
	4		6
	1		7
	3		1

The numbers in array B show the position of the numbers in ascending order as they appear in array A (0 is the fourth position in array A, and is shown as a 4 in position 1 of array B).

Example (DIDX)

```
20 OPTION BASE 1
30 DIM A(10), B(10)
40 MAT B=DIDX(A)
```

If array A is	9	array B will be	1
	5		7
	6		6
	0 (position four)		3
	2		2
	7		8
	8		10
	4		5
	1		9
	3		4 (position ten)

The numbers in array B show the position of the numbers in descending order as they appear in array A (0 is the fourth position in array A, and is shown as a 4 in position 10 of array B).

Programming considerations

The array on the left of the equal sign must be numeric.

The results of using AIDX or DIDX are dependent on the collating sequence that is in effect. See "OPTION statement" and "IF, THEN, ELSE statement." See also "COLSEQ" in the *Customer Support Functions, Volume II.*

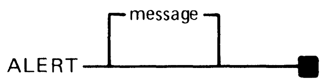
Each element of the array on the right is compared to every other element in that array to determine the index for that element. The index is then stored in the array on the left. Operation continues until the indexes for all elements of the

AIDX and DIDX (continued)

array on the right are determined. No check is made to assure that the target array is not the source array.

ALERT command

The ALERT command indicates that the operator's attention is needed during the operation of a procedure file (see "Procedure file"). Remarks are not allowed, they are interpreted as part of the message.



The syntax of the ALERT command is shown above. When executed, the ALERT command:

- Halts the system operation
- Sounds the alarm
- Displays the word ALERT and an optional message on line 22 of the display screen

The following is what the ALERT command with an optional message might look like:

ALERT REPLACE DISKETTE1 WITH DISKETTE2

The operator is informed that the diskettes must be changed.

ALERT command (continued)

Any command may be issued, and when the command has finished processing, the keyboard is reopened for input. To continue executing the procedure file type GO and press Enter.

To exit the procedure that issued the ALERT command enter one of the following:

- GO END
- CLEAR PROC
- PROC (for another procedure)
- CLEAR ALL

Alphabetic character set

see
''Character set''

Arc tangent

see ''ATN(X)''

Arithmetic arrays

An arithmetic array contains only numeric data and can have one or two dimensions. A one-dimensional array is a list of data items. A two-dimensional array is a matrix of rows and columns.

A(0)
A(1)
A(2)
A(3)

B(0,0)	B(0,1)	B(0,2)	B(0,3)
B(1,0)	B(1,1)	B(1,2)	B(1,3)
B(2,0)	B(2,1)	B(2,2)	B(2,3)
B(3,0)	B(3,1)	B(3,2)	B(3,3)

Note: In the above example BASE 0 is being used. For information about BASE 0 and BASE 1, see "OPTION statement".

All elements of a numeric array (except an array received from a chaining program) are initially set to zero during the execution of the first statement that references the array.

Before being used in any of the matrix handling statements (MAT statements), an arithmetic array must be *declared* or *dimensioned*. For information on dimensioning arrays, see "DIM statement," "Declaring arrays," "Redimensioning arrays", or "MAT assignment statements".

If an array is not explicitly declared in a DIM statement, the highest subscript it can have is 10. The first reference to the array determines if the array is one- or two-dimensional.

Arithmetic data

Arithmetic data is data with a numeric value. All numbers in BASIC are decimal numbers (base 10).

Magnitude

The magnitude of a number is its absolute value. In BASIC, a power of 10 is represented by the letter E. The E is written between the first and second constant so that 10**126 becomes 1E+126 or 1E126. 1E−126 and 1E+126 are called floating-point numbers or notations. Floating-point notation is simply a shorthand way of expressing very large or very small numbers. See "Floating-point format" under "Arithmetic data". The range of numbers permitted in a BASIC program are numbers that are greater than 1E−126 and less than 1E+126.

Significance

The significance of a number is the number of digits it contains excluding leading and trailing zeros. For the System/23, the number is 15 digits. Numbers that are entered, are truncated to 15 digits. Numbers that are the result of an arithmetic operation, are rounded to 15 digits.

Accuracy

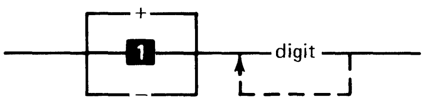
Additions and subtractions are accurate to 15 digits. Multiplications and divisions return 15 digits accurate to 14 digits. EXP, SQR, and exponentiation return 13 digits accurate to 12 digits. LOG, SIN, COS, TAN, and ATN return 15 digits accurate to at least 10 digits. The remaining system functions are accurate to 15 digits.

Arithmetic data formats

There are three data formats available for entering, displaying, and printing numbers: integer, fixed-point, and floating-point. Numbers in any of the formats can be positive or negative. Negative numbers must be preceded by a minus sign. Positive numbers may or may not have a plus sign.

Integer format. An integer is a whole number with no decimal point. The integer format is the same as conventional representation. A positive number may or may not be preceded by a sign.

Integer format



1 Positive number

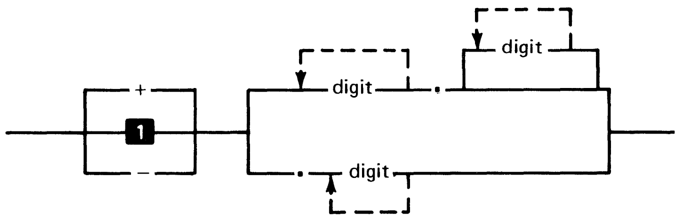
Here are some examples:

```
0
+2
-23
266
```

Arithmetic data (continued)

Fixed-point format. Numbers expressed in fixed-point format are written as a number of digits preceded by a sign and followed by a decimal point (+3.). The decimal point may also be followed by digits which express the decimal fraction (+3.56).

Fixed point format

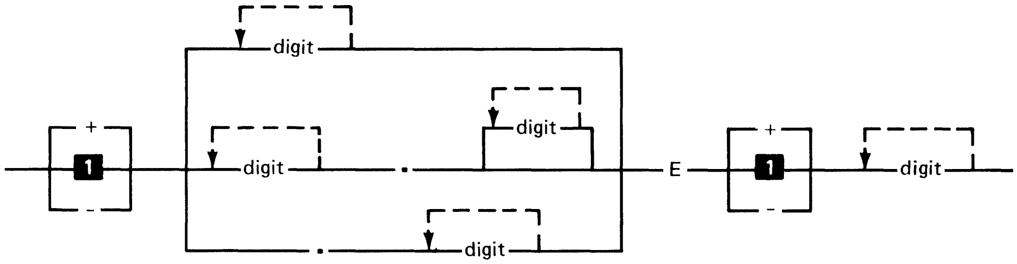


1 Positive number

Examples of fixed point are:

```
-.3
+3.56
33.00
33.
```

Floating-point format. When working with very large or very small numbers, the floating-point format is the easiest to use. Floating-point numbers are written with a fixed-point number, followed by the letter E (E stands for multiplied by ten to the power of), and followed by a one, two, or three-digit exponent.



1 Positive number

An example of floating-point format is:

-3.1E7

The value of the floating-point number is -3.1 multiplied by 10 to the power of 7.

-3.1E7 is the same as -3.1x 10^7

-3.1E7 is the same as -31,000,000

Note that the number E7 is not a valid floating-point number. The value 10^7 must be expressed as 1E7 in BASIC floating-point format.

Arithmetic data (continued)

Selecting an arithmetic format. An arithmetic value can be entered at the keyboard in the most convenient format for the application. The number one million, for example, can be entered in any of the following ways:

```
1000000
1000000.00
1E6
+10E5
+100E+4
```

Arithmetic constant

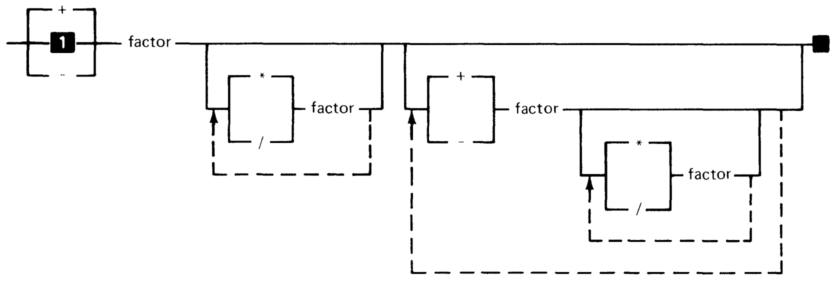
An arithmetic constant is either an integer, a fixed-point, or a floating-point value appearing in a BASIC statement. The value of the constant remains the same within the program. For example, the integer 1 is a constant in the statement

```
100 LET X=X+1
```

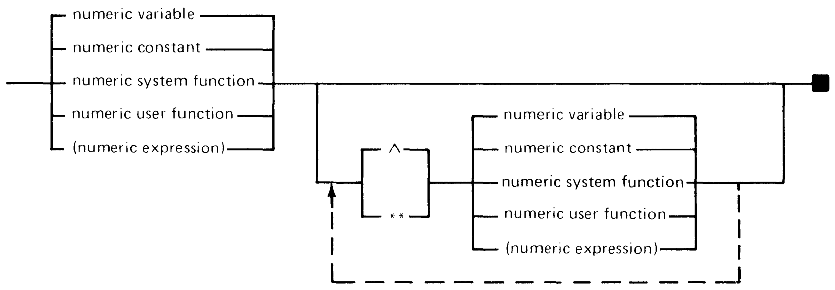
Arithmetic expressions and operations

Syntax

Numeric expression



Factor



1 Positive number

A numeric expression can be an arithmetic variable, array element, constant, or operational reference; or it can be a series of these items connected by operators and parentheses. Examples of arithmetic expressions are:

```
ALPHA+1
BETA-3/(-6)
X+Y+Z
A7*(B*3+3)
```

Arithmetic expressions and operations (continued)

BASIC performs addition, subtraction, multiplication, division, and exponentiation. The five operators used in most formulas are:

Function	Meaning	Example
+	add, positive	10+2=12
–	subtract, negative	10–2=8
*	multiply	10*2=20
/	divide	10/2=5
** or ^	exponentiation	10**2=100
	(10 raised to the power of 2)	10^2=100

Rules for the arithmetic operators and the resulting actions are as follows:

Addition and multiplication: A+B and A*B are both commutative; or, A+B=B+A and A*B=B*A. However, addition and multiplication are not always associative because of rounding; for example, A*(B*C) does not necessarily give the same results as (A*B)*C.

Example:

```
5 FOR I=1 to 3
10 LET A=RND
20 LET B=RND
25 LET C=RND
26 LET D=A*B*C
27 LET E=A*(B*C)
30 PRINT USING 35:D,E,D-E
35 FORM 3*N 25.17
40 NEXT I
```

Results of three typical loops:

- Contents of D
  .04558553601442990 (first time)
  .00548795587029670 (second time)
  .43103396752564700 (third time)

- Contents of E
  .04558553601443000 (first time)
  .00548795587029669 (second time)
  .43103396752564700 (third time)

- Difference (D-E)
  .00000000000000010 (first time)
  .00000000000000001 (second time)
  .00000000000000000 (third time)

Subtraction: A–B is defined as A minus B.

Division: A/B is defined as A divided by B. If B=0 and A is not 0, an error (zero divide) occurs.
If A=0 and B=0 the result is 1.

Arithmetic expressions and operations (continued)

Exponentiation: The expression A**B or A ^ B is defined as the value of the variable A raised to the B power. The following rules apply to exponentiation:

- If A=0 and B<0, a zero divide error is returned
- If A<0 and B is not an integer, an error occurs because of a negative number to a fractional power
- If B=0, A**B equals 1
- If A=0 and B>0, A**B equals 0

Considerations:

- Exponentiation returns 13 digits accurate to 12.
- The circumflex(^)can also be used for exponentiation; however, the system converts the circumflex to **. The circumflex key on the keyboard does not advance the cursor.

Positive/Negative Operations: The + and – signs can also be used as positive/negative operators. These positive/negative operators can be used in only two situations. They are:

- Following a left parenthesis and preceding an arithmetic expression
- As the leftmost character in an entire arithmetic expression

For example:

–A+(–B) and B–(–2) are valid

A+–B and B––2 are invalid

For more information on arithmetic expressions and operations, see "Arithmetic hierarchy".

Subjects related to arithmetic expressions

ABS	DISPLY	LINE	RND
AIDX	ERR	LOG	ROUND
ATN	EXP	MAX	SGN
CEIL	FILE	MIN	SIN
CMDKEY	FILENUM	ORD	SQR
CNT	FREESP	PI	SRCH
CODE	INT	POS	TAN
CON	KLN	PROCIN	UDIM
COS	KPS	REC	VAL
DIDX	LEN	RLN	ZER

Arithmetic hierarchy

Expressions with two or more operations are performed according to the hierarchy of the operations involved. BASIC performs the operations in the following order:

1. Parentheses receive top priority. When parentheses are nested (within another set of parentheses), the operation in the innermost pair is performed first.

2. If there are no parentheses, the order of priority is:
   a. Exponentiation (^ or **).
   b. Positive and negative.
   c. Multiplication (*) and division (/) have equal priority.
   d. Addition (+) and subtraction (–) have equal priority.

3. If the items are of equal priority, then the evaluation of the operators is from left to right. The following are examples of arithmetic hierarchy, showing how expressions are evaluated:

- Parentheses ( )
  70 – (25 + 15) = 70 – 40 = 30

- Exponentiation **
  10 + 10**2 = 10 + 100 = 110

- Multiplication * or Division /
  10 + 10*2 = 10 + 20 = 30
  10 + 10/2 = 10 + 5 = 15
  10 + 10*2/5 = 10 + 20/5 = 10 + 4 = 14

- Addition + or Subtraction –
  10 + 10 = 20
  10 – 5 = 5
  10 + 10 – 5 = 20 – 5 = 15

- Nested Parentheses
  150/(2*(13 + 12)) = 150/(2*25) = 150/50 = 3

The entire hierarchy would be as described below:

In Step 1, the nested parentheses (13 + 12) is performed.

Step 1. 50 + 10**2/(2*(13 + 12)) − 2 =

In Step 2, the parentheses (2*25) is performed.

Step 2. 50 + 10**2/(2*25) − 2 =

In Step 3, the exponentiation 10**2 is performed.

Step 3. 50 + 10**2/50 − 2 =

In Step 4, the division 100/50 is performed.

Step 4. 50 + 100/50 − 2 =

In Step 5, because addition and subtraction have equal priority, the priority is from left to right. The addition 50+2 is performed.

Step 5. 50 + 2 − 2 =

In Step 6, the final step, the subtraction 52-2 is performed and the answer is shown.

Step 6. 52 − 2 = 50

See "Arithmetic expressions and operations".

Arithmetic variables

A variable represents a number whose value is subject to change during the execution of the program. Arithmetic variables have names consisting of from one to eight alphabetic or numeric characters, with the first being alphabetic. Examples of valid variable names are:

```
A5
BASIC
DATA1
BYTE12
```

Arithmetic variables are stored internally as decimal floating point.

An arithmetic variable is initially set to zero during the execution of the first statement that references the variable (except when the variable is received from a chaining program).

Some names are reserved by the system and cannot be used for variables or labels. See ''Reserved words.'' The term variable includes array elements (see ''Arithmetic arrays'').

Array expressions

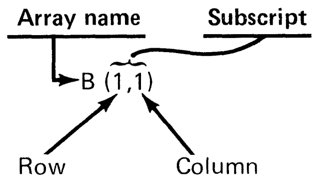
see ''MAT assignment statements''

Arrays

An array is a collection of data items (elements) that is referred to by a single name. Only data items of the same type (numeric or character) can be grouped together to form an array. It is a convenient tool that provides a fast and organized way of handling large amounts of data within a program.

Arrays can be either one- or two-dimensional. A one-dimensional array can be thought of as a list of successive data items. A two-dimensional array can be thought of as a matrix of rows and columns.

Each element in an array is referred to by the name of the array followed by a subscript enclosed in parenthesis. Array subscripts can begin with either zero (BASE 0 indexing) or one (BASE 1 indexing). You can select the base by using the OPTION statement (see "OPTION statement"). The default is BASE 0.



OPTION BASE 0 indicates that the first element of an array has a subscript of 0.

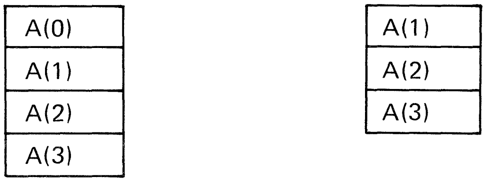
OPTION BASE 1 indicates that the first element of an array has a subscript of 1.

Arrays (continued)

There are two types of subscripts. One is specified by a single number after the array name, such as A(3).

For example:

```
10 OPTION BASE 1
20 DIM A(3) !DEFINES A ONE-DIMENSIONAL ARRAY
 •
 •
 •
60 LET A(3)=468.45 !REFERENCES THIRD ELEMENT
```



Base 0 (default)

Base 1

Note: If OPTION BASE 1 was not specified, then statement 60 would be referencing the fourth element.

The other type of subscript has two numbers after the variable name, such as B(3,3).

For example:

```
10 OPTION BASE 1
20 DIM B(3,3) !DEFINES TWO-DIMENSIONAL ARRAY
30 LET B(2,2)=9.6 !REFERENCES ROW 2, COLUMN 2
```

B(0,0)	B(0,1)	B(0,2)	B(0,3)
B(1,0)	B(1,1)	B(1,2)	B(1,3)
B(2,0	B(2,1)	B(2,2)	B(2,3)
B(3,0)	B(3,1)	B(3,2)	B(3,3)

Base 0
(default)

B(1,1)	B(1,2)	B(1,3)
B(2,1)	B(2,2)	B(2,3)
B(3,1)	B(3,2)	B(3,3)

Base 1

Arrays (continued)

When referencing an element in a one-dimensional array, the position of the element is obtained by counting from top to bottom. Thus, assuming BASE 0, the fourth element of a one-dimensional array named A can be referenced by the symbol:

```
A(3)
```

The first value in a subscript of a two-dimensional array gives the number of the row containing the referenced element. Rows are numbered from top to bottom. The second value in the subscript gives the number of the column. Columns are numbered from left to right. Thus, assuming BASE 0, the third element in the fifth row of a two-dimensional array named B can be referenced by the symbol:

```
B(4,2)
```

Each subscript value can also be an arithmetic expression. For example, if I=3 then row 5, column 3 of the array named B can be referenced by the symbol:

B(I+1,2)

The maximum subscript is 9999.

See "Sample program 1" in Appendix A.

Arrays, arithmetic

see "Arithmetic arrays"

Arrays, character

see ''Character arrays''

Arrays, declaring

see ''Declaring arrays'' under ''DIM statement''

Arrays, redimensioning

see ''Redimensioning arrays''

Ascending index

see ''AIDX and DIDX''

Assignment statements

see ''LET statement''

ATN(X)

Returns the arc tangent of X, where X is in radians.

Attention and Inquiry (continued)

A BASIC program may be interrupted by the operator in one of two ways:

- Cmd/Attn (press and hold Cmd key and press Attn key)
- Inq (Inquiry) key.

Cmd/Attn can be used at any time and will stop the execution of a BASIC program following the statement during which it is pressed. The System/23 goes into "split screen mode".

If the Cmd/Attn is detected during a user defined function, the program gets an error indicating that a user function was interrupted. The operator resumes normal execution with Error Reset or may terminate the user function with Cmd/Error Reset which abandons execution of the function. (GO will continue execution following the line which invoked the function.) See "DEF, FNEND statement".

If a procedure is running, the procedure is interrupted following the command being executed.

If Cmd/Attn is pressed during the execution of a RUN command in a procedure, the program interrupts the same as without a procedure. To interrupt the procedure when the program ends, cause the program to end with a PAUSE statement. Then enter commands and/or restart the procedure.

The commands LOAD, SAVE, and REPLACE cannot be interrupted.

During an interrupt any system commands or calculator statements can be entered. Some statements will prevent resumption of the interrupted program or procedure (for example, CLEAR, LOAD, and LINK).

Some statements will be rejected if their execution would cause ambiguous results (editing OPTION, DIM, FOR, or NEXT statements).

Normal execution can be resumed by entering GO.

No error code is set by Cmd/Attn.

The Inq key also interrupts a BASIC program. The response to the Inq key is controlled by the ON statement (see "ON statement"). The default action is to interrupt execution with a 0001 error. The ON statement may also specify that the Inq key be IGNORED or cause a GOTO when it is pressed. The inquiry key is ignored during execution of a GOTO statement. It is not advisable to execute a one-statement loop (10 GOTO 10) while waiting for the Inq key to be pressed. The CONTINUE statement may be used to return control to the interrupted task (see "CONTINUE statement").

The Inq key is not checked while a defined function is executing. It is processed normally after all defined functions are completely executed.

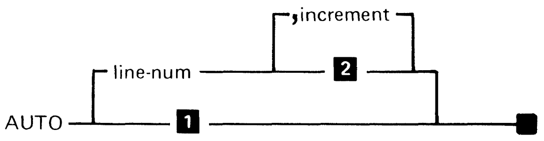
Inadvertantly pressing the HOLD or TEST keys may result in entering system diagnostic mode.

See "Sample program 1" in Appendix A.

AUTO command

The AUTO command provides automatic numbering of program lines or DATA statements. The starting line number and the increment can be specified. If a beginning line number or increment value are not specified, a beginning line number of 10 and an increment of 10 is generated for BASIC programs or data statements.

Be sure that the AUTO command does not replace existing lines if not desired.



1 AUTO 10, 10
2 AUTO line-num,10

The syntax of the AUTO command is as shown where:

line-num is a positive number specifying the first line number to be generated. The range of this number is from 1 to 99999. The default is 10.

increment is a positive integer from 1 to 99998 used to increment succeeding line numbers. If a beginning line number is not specified, the increment cannot be specified. The default is 10.

Each line number generated by the AUTO command for a BASIC program is followed by a blank, then the cursor.

```
00010 _
```

When working with a data file, the line number is followed by a colon and then the cursor.

```
00010:_
```

Examples:	**To use line numbers**
AUTO	10,20,30,40,etc.
AUTO 15	15,25,35,45,etc.
AUTO 15,5	15,20,25,30,etc.
AUTO 150,25	150,175,200,225,etc.

Programming considerations

- Ending AUTO
  - Automatic line numbering continues until the line number put on the screen is overwritten or an empty line is scrolled up.
- Procedures
  - Automatic line numbering cannot be done from a procedure file.
- Entering DATA
  - If AUTO is used to enter data, CLEAR DATA or LOAD...,DATA must be issued first.
- Adding lines
  - To find the last line for continued entry: LIST 99999

Be sure that the AUTO command does not replace existing lines if not desired.

BASIC statements

A BASIC program is made up of BASIC statements. BASIC statements allow you to enter data, specify how that data is to be manipulated, and determine what is the output. BASIC statements are either executable or descriptive (nonexecutable). Executable statements cause a program action such as value assignment or printing. Descriptive statements provide information needed by the program or the user, but they cause no visible action.

BASIC statements can be up to 255 characters including six for the line number and following blank. The maximum number of statements permitted in a single BASIC program is limited by the work area size of the system, the statement types, and the maximum line number (99999).

The statements and a brief description are listed here.

CHAIN	Ends a program, then loads and begins executing another program or a procedure
CLOSE	Closes a file that is open
CONTINUE	Transfers control to the statement following the one causing the ON-condition transfer or I/O exit
DATA	Creates an internal data table of values
DEF	Defines a function to be used in the program
DELETE	Marks a specific record in an internal I/O file as unavailable (deleted)
DIM	Specifies the size of an array or character variable length
END	Ends a program
EXIT	Specifies error exits for corresponding error conditions
FNEND	Ends a function defined in a DEF statement

FOR	Begins a loop and determines when loop is exited (as used with a NEXT statement)
FORM	Specifies format for displayed/printed input/output and records in files
GOSUB	Transfers control to the beginning of a subroutine
GOTO	Transfers control to a specific statement
IF,THEN,ELSE	Transfers program control or executes a statement according to the results of the logical expression
INPUT	Assigns values from the keyboard or other device to variables or array elements during program execution
LET	Assigns values to variables
LINPUT	Performs unformatted character string input
MAT	Assign values to all elements of an array.
NEXT	Last statement in a loop (see FOR)
ON	Specifies a transfer of control on the detection of specified events
OPEN	Activates internal or display files for input or output
OPTION	Set global parameters of BASIC program
PAUSE	Halts program execution
PRINT	Transfers DISPLAY data to a specified device
RANDOMIZE	Sets a new starting point in random number generator
READ	Assigns values from the internal table (see DATA) or internal I/O files to variables or array elements
REM	Defines comments or remarks in a program

BASIC statements (continued)

REREAD	Allows access to the last record obtained from a file
RESTORE	Causes values in the internal data table (see DATA) to be assigned starting with the first table value, resets the data file to the beginning or to a specific record
RETRY	Transfers control to the statement causing the most recent error
RETURN	Ends a current subroutine
REWRITE	Updates existing record in a file
STOP	Stops execution of program statements
TRACE	Traces all or part of a program's execution
USE	Defines the names of the variables passed by the CHAIN statement
WRITE	Adds a record to an internal I/O file

Note: More information on individual statements may be found by locating the statement, which is in alphabetic order, in this manual.

Blanks

The following rules apply to the use of blanks:

- Blanks can be used within quoted character strings.
- A blank or other syntactically defined delimiter is required after a keyword.
- Blanks are not allowed within keywords, variable names, numeric constants, function names, line numbers, and labels.
- Non-significant blanks will be deleted when the program is listed (see "LIST command").
- Blanks are required after leading line numbers in BASIC statements.
- To retain blanks, the program must be entered/edited in DATA mode.
- Blanks are significant in relational compares.

Throughout this reference manual the symbol ƀ will represent a blank.

Byte

The unit of machine and diskette storage. For example, one character takes one byte.

Catenation

see ''Concatenation''

CEIL(X)

Returns the smallest whole number (integer) greater than or equal to X. For example:

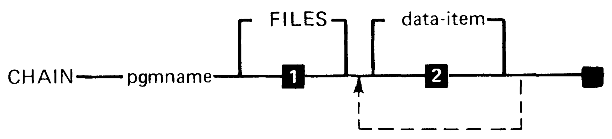
```
10 CEIL (-1.2)=-1

20 CEIL (+2.3)=3
```

Ceiling

see ''CEIL(X)''

CHAIN statement

The CHAIN statement ends the program currently being executed, loads another program, and starts executing the new program. The CHAIN statement may also be used to start a procedure or a subprocedure from a BASIC program.



1 All files are closed
2 No data is passed

The syntax of the CHAIN statement is as shown above, where:

pgmname is a character expression representing the program name (see "File specifications"). If the first five characters of *pgmname* are PROC=, then the file is invoked as a procedure. If the first eight characters are SUBPROC=, then the file is invoked as a subprocedure. In either case, *FILES* and *data-item* may not be specified.

FILES indicates that all files of the current program remain open and at their current positions. If the keyword FILES is not specified, all files except procedure files are closed when the CHAIN statement is executed.

data-item is the name of a variable or array (without the keyword MAT).

The data items define the names of the variables that are to retain their data when the chain occurs. All other variables are destroyed during the chaining operation. The list of data

CHAIN statement (continued)

items is not syntax checked until the CHAIN statement is executed.

Examples

In the following example, the current program is terminated, all files are kept open, PGM3 from VOL1 is loaded, and the values of variables A and B$ are copied into the chained-to program.

```
10 CHAIN "PGM3/VOL1", FILES, A, B$
```

In the following example, the system chains to the procedure file "PROC4". In statement 70, the "PROC=" is necessary to indicate that "PROC4" is a procedure and not a program.

```
70 B$ = "PROC=PROC4"
80 CHAIN B$
```

If a procedure was already in effect, it is replaced with the new procedure, PROC4.

An example of CHAIN specifying the subprocedure is

```
90 CHAIN "SUBPROC=SET.TIME"
```

If a procedure was already in effect, it resumes control when the subprocedure is finished.

Programming considerations

- USE
  - The chained program must contain a USE statement that specifies the same variables in the same order as the CHAIN statement (see "USE statement").
- Dimensioning
  - The chaining and the chained program must be dimensioned the same as all the arrays and the character variables that are passed. The programs can redimension the arrays in any valid manner (see "Redimensioning arrays").
- Options
  - The options specified on an OPTION statement in the chained-from program must match the options specified in the chained-to program.
- IF, THEN, ELSE
  - There cannot be an ELSE clause when the CHAIN statement is the object of a THEN clause. Only a remark can follow the data items in a CHAIN statement.
- CHAIN interrupt
  - If CHAIN processing gets interrupted for any reason while LOAD appears on the status line (for example, file not found) and if termination is desired, CLEAR ALL must be entered.

See "Sample program 7" in Appendix A.

Character arrays

A character array contains only character data and can have one or two dimensions.

Character arrays, like simple character variables, are named by a single letter of the alphabet followed by zero to seven alphabetic or numeric characters, followed by the dollar sign $.

For example:

```
D$(5) = "JONES"
A5$(10) = "SMITH"
```

Character arrays can be used in input, output, and simple matrix assignment statements and can be redimensioned (except for maximum string length). The maximum string length of each element of a character array cannot changed.

For more information, see:

"Arrays"

"Character variables"

"Redimensioning arrays"

"DIM statement"

"VAL(A$)"

Character constants

A character constant is a string of characters enclosed in quotation marks. Any letter, digit, or special character can be in a character constant. For example "THE PRICE IS $6.95." represents THE PRICE IS $6.95.

The character constant, including blanks but excluding the delimiting quotation marks, may be from zero through 255 characters long. The following are examples of valid character constants:

```
"YES"
"HE SAID ""HELLO"""
"123456"
```

Lowercase characters within quotes (constants) are not changed to uppercase.

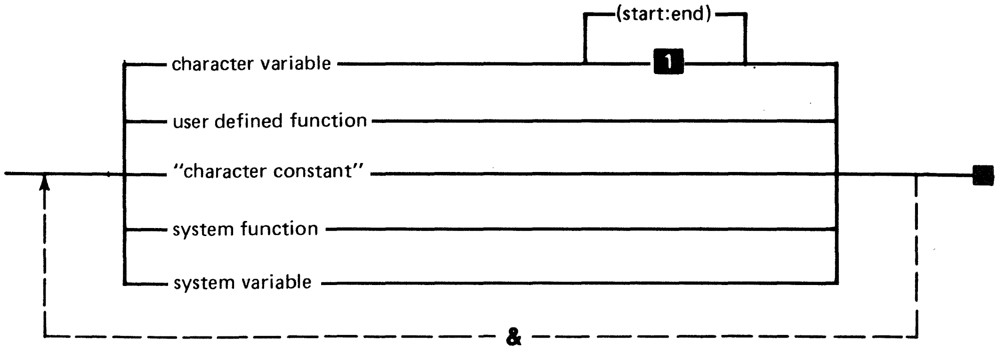
To represent quotes within character strings, two consecutive quotes ("") are required.

Character data

Character data in BASIC is data with a character value. It can be in the form of constants or variables (see "Character constants" and "Character variables").

Character expressions

Syntax



1 Entire variable

Start and End are numeric expressions.

A character expression is a character constant, a character variable, a character operation reference, a single element of a character array, a character substring, or a combination of these. The only operators ever associated with character expressions are the substring and the concatenation symbol. For more information, see "Concatenation" and "Substring referencing." The following are examples of character expressions:

```
"ABCDEFG123456"
ALPHA$ & BETA$
"SER" & "IAL"
ZEBRA$(2:6)
```

Subjects related to character expressions

This section lists and summarizes subjects related to character expressions. For additional information, refer to the specific subject in this manual.

Character set	See charts under this topic
CHR$	Returns character for specified position within collating sequence
Concatenation	Joins character strings together
DATE$	Returns date set by DATE command
FILE$	Returns file specification
FORM statement	Specifies format for displayed/printed input/output and for records in files
HEX$	Returns hexadecimal value
KSTAT$	Returns the most recent keystroke
LEN	Returns the length of a string
LPAD$	Returns a string padded on the left with blanks
LTRM$	Returns a string with leading blanks removed
ORD	Returns ordinal value
PIC$	Returns/changes the current currency symbol
POS	Returns position of matching substring

Character expressions (continued)

RPAD$	Returns a string padded on the right with blanks
RPT$	Returns repeated character
RTRM$	Removes trailing blanks
SRCH	Searches array for a value
SREP$	Replaces strings past a specified position with another string
STR$	Converts a specified value to a character string
TIME$	Returns time of day (set initially by TIME command)
WSID$	Returns which port of the 5246 Diskette Unit the 5322 Computer is attached to

Character set

The System/23 character set is used to represent arithmetic and character data as data constants and variables and to represent the BASIC program.

The character set consists of the following:

- Alphabetic characters (English)
- Alphabetic characters (non-English)
- Numeric characters
- Special characters
- Graphic characters

Alphabetic characters (English)

The uppercase and lowercase letters of the alphabet (A through Z make up the System/23 alphabetic characters). See "Character set."

Alphabetic characters (non-English)

Characters of the alphabet that are non-English may not be used for BASIC variable names and file names.

Numeric characters

In BASIC, the numeric characters are the digits 0 through 9.

Character set (continued)

Special characters

There are 21 characters that have special meaning in System/23 BASIC:

Character	Name
	Blank or space
=	Equal sign
+	Plus sign
–	Minus sign
*	Asterisk
/	Slash
∧	Circumflex
(	Left parenthesis
)	Right parenthesis
,	Comma
.	Period or decimal point
;	Semicolon
:	Colon
&	Ampersand, concatenation
?	Question mark
>	Greater than
<	Less than
!	Exclamation point
$	Currency symbol
"	Quote
#	Number sign

The cursor does not move to the right when using the circumflex. The cursor right key must be used.

There are other special characters but they do not have special meaning in System/23 BASIC. They are used within character strings.

Graphic characters

There are 11 graphic characters in System/23 BASIC:

• Vertical bar	│
• Lower right corner	┘
• Lower tee	┴
• Left tee	├
• Upper tee	┬
• Upper left corner	┌
• Lower left corner	└
• Upper right corner	┐
• Right tee	┤
• Horizontal bar	─
• Intersection	┼

Note: On the printers, small gaps may be visible between graphics.

Character set (continued)

Display attributes, highlight and blink, do not affect these graphic characters.

The following chart lists all of the EBCDIC characters and their hexadecimal representation used in System/23 BASIC.

Column		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
	→ Bit	00				01				10				11			
Row	Pat. ↓	00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11
0	0000			┘	┐	SP	&	–	ϕ	ϕ	°	µ	¢	{	}	\	0
1	0001			┴	┤	RSP	é	/	É	a	j	˜	£	A	J	NSP	1
2	0010			├		â	ê	Â	Ê	b	k	s	¥	B	K	S	2
3	0011			U		ä	ë	Ä	Ë	c	l	t	Pt	C	L	T	3
4	0100	H	Norm	ND	—	à	è	À	È	d	m	u	ƒ	D	M	U	4
5	0101				RHB	á	í	Á	Í	e	n	v	§	E	N	V	5
6	0110					ã	î	Ã	Î	f	o	w	¶	F	O	W	6
7	0111	B	UR	RH		å	ï	Å	Ï	g	p	x	¼	G	P	X	7
8	1000	R	URH	┬		ç	ì	Ç	Ì	h	q	y	½	H	Q	Y	8
9	1001		URB	┌		ñ	β	Ñ	`	i	r	z	¾	I	R	Z	9
A	1010	HB	URBH			[	]	¦	:	«	a̲	¡	¬	SHY	¹	²	³
B	1011	RB	|			.	$	,	#	»	o̲	¿	|	ô	û	Ô	Û
C	1100		UH	└		<	*	%	@	đ	æ	Đ	¯	ö	ü	Ö	Ü
D	1101		UB			(	)	_	'	ý	¸	Ý	¨	ò	ù	Ò	Ù
E	1110		UBH		┼	+	;	>	=	þ	Æ	Þ	´	ó	ú	Ó	Ú
F	1111					!	^	?	"	±	¤	®	‗	õ	ÿ	Õ	EO

Notes:

Character set (continued)

Special use characters

The following shows characters that perform a special function on the display screen and/or printer. An X indicates that the device supports the function.

Hex	ID	Screen	Printer	Use
04	H	X	-	Highlight
06	New line	Blank	X	Start output in column 1, next line
07	B	X	-	Blink
08	R	X	-	Reverse image
0A	HB	X	-	Highlight blink
0B	RB	X	-	Reverse image,blink
0C	New Page	X	X	Screen=clear, printer=eject page
0D	CR	X	X	Carrier return
11		Blank	X	System use only
12		Blank	X	System use only
13		Blank	X	System use only
14	N	X	X	Screen=normal image,no blink,highlight,underline Printer=stop underline
15	New line	X	X	Start output in column 1,next line
17	UR	X	-	Underline,reverse image
18	URH	X	-	Underline,reverse image,highlight
19	URB	X	-	Underline,reverse image,blink
1A	URBH	X	-	Underline,reverse, blink,highlight
1C	UH	X	-	Underline,highlight
1D	UB	X	-	Underline,blink
1E	UBH	X	-	Underline,blink, highlight
23	U	X	X	Underline
24	I	X	-	Invisible
25	Line feed	Blank	X	Start output in same column,next line
27	RH	X	-	Reverse,highlight
2B	Format	Blank	X	Set printer
35	RHB	X	-	Reverse image, highlight,blink
3A	Page End	Blank	X	Eject page
3B		Blank	X	System use only
3C		Blank	X	System use only

Character set (continued)

Characters not displayable

Not all graphics can be displayed at the same time (see "DISPLY"). Characters that are not displayable show up as "blobs." All graphics always print on the printer (except 1/4, 1/2, and 3/4 on some printers).

The following charts show which characters are not displayed for each setting of DISPLY. Non-displayable characters are shown in the shaded boxes.

DISPLY(1) — United States character set:

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0						&	–	ϕ	■	°	µ	¢	{	}	\	0
1						é	/	■	a	j	˜	£	A	J		1
2					■	■	■	■	b	k	s	¥	B	K	S	2
3					■	■	■	■	c	l	t	Pts	C	L	T	3
4					■	■	■	■	d	m	u	ƒ	D	M	U	4
5					á	í	■	■	e	n	v	§	E	N	V	5
6					ã	■	Ã	■	f	o	w	¶	F	O	W	6
7					■	ï	■	■	g	p	x		G	P	X	7
8					ç	■	Ç	Ì	h	q	y		H	Q	Y	8
9					ñ	β	Ñ	`	i	r	z		I	R	Z	9
A					[	]	¦	:	«	ª	¡	¬		¹	²	³
B					·	$	,	#	»	º	¿	┤	■	■	■	■
C					〈	★	%	@	■	■	■	-	■	ü	■	■
D					(	)	–	'	■	s	■	¨	■	■	Ò	■
E					+	;	〉	=	■	■	■	´	ó	ú	■	■
F					!	^	?	"	±	■	®	=	ò	■	Ò	

DISPLY(2) — Canada character set:

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0						&	–	■	■	°	µ	¢	{	}	\	0
1						é	/	É	a	j	˜	£	A	J		1
2					â	ê	Â	Ê	b	k	s	¥	B	K	S	2
3					■	ë	■	Ë	c	l	t	■	C	L	T	3
4					à	è	À	È	d	m	u	ƒ	D	M	U	4
5					■	■	■	■	e	n	v	§	E	N	V	5
6					■	î	■	Î	f	o	w	■	F	O	W	6
7					■	ï	■	Ï	g	p	x	■	G	P	X	7
8					ç	■	Ç	Ì	h	q	y		H	Q	Y	8
9					■	■	■	`	i	r	z	■	I	R	Z	9
A					[	]	¦	:	«	■	■	¬		^{1}	^{2}	^{3}
B					·	$	,	#	»	■	■	|	ô	û	Ô	Û
C					⟨	★	%	@	■	■	■	‾	■	ü	■	Ü
D					(	)	–	'	■	s	■	¨	■	ù	■	Ù
E					+	;	⟩	=	■	■	■	´	■	■	■	■
F					!	^	?	"	■	■	■	=	■	ÿ	■	

DISPLY(3) — Europe (except Spain) character set:

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0						&	–	ø	Ø	°	µ	■	{	}	\	0
1						é	/	É	a	j	˜	£	A	J		1
2					â	ê	■	■	b	k	s	¥	B	K	S	2
3					ä	ë	Ä	■	c	l	t	■	C	L	T	3
4					à	è	■	■	d	m	u	ƒ	D	M	U	4
5					■	■	■	■	e	n	v	§	E	N	V	5
6					■	î	■	■	f	o	w	■	F	O	W	6
7					å	ï	Å	■	g	p	x	■	G	P	X	7
8					ç	ì	■	Ì	h	q	y		H	Q	Y	8
9					■	β	■	`	i	r	z	■	I	R	Z	9
A					[	]	¦	:	■	■	■	¬		^{1}	^{2}	^{3}
B					·	$	,	#	■	■	■	|	ô	û	■	■
C					⟨	★	%	@	■	œ	■	‾	ö	ü	Ö	Ü
D					(	)	–	'	■	s	■	¨	ò	ù	Ò	■
E					+	;	⟩	=	■	Æ	■	´	■	■	■	■
F					!	^	?	"	■	¤	■	=	■	ÿ	■	

Character set (continued)

DISPLY(4) — Nordic (including Iceland) character set:

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0						&	–	ϕ	ϕ	°	■	■	{	}	\	0
1						é	/	É	a	j	˜	£	A	J		1
2					■	■	■	■	b	k	s	¥	B	K	S	2
3					ä	■	Ä	■	c	l	t	■	C	L	T	3
4					■	■	■	■	d	m	u	ƒ	D	M	U	4
5					á	í	Á	Í	e	n	v	§	E	N	V	5
6					■	■	■	■	f	o	w	■	F	O	W	6
7					å	ï	Å	■	g	p	x	■	G	P	X	7
8					■	■	■	■	h	q	y		H	Q	Y	8
9					■	β	■	`	i	r	z	■	I	R	Z	9
A					[	]	¦	:	■	■	■	¬		¹	²	³
B					·	$	,	#	■	■	■	┤	■	■	■	■
C					⟨	★	%	@	đ	æ	Đ	¯	ö	ü	Ö	Ü
D					(	)	–	'	ý	¸	ý	¨	■	■	Ò	■
E					+	;	⟩	=	þ	Æ	Þ	´	ó	ú	Ó	Ú
F					!	^	?	"	■	¤	■	=	■	■	■	

DISPLY(5) — Spain (Spanish speaking) character set:

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0						&	–	■	■	■	■	¢	{	}	\	0
1						é	/	■	a	j	˜	£	A	J		1
2					â	ê	■	■	b	k	s	¥	B	K	S	2
3					ä	ë	Ä	■	c	l	t	■	C	L	T	3
4					à	è	■	■	d	m	u	ƒ	D	M	U	4
5					á	í	■	■	e	n	v	■	E	N	V	5
6					■	î	■	■	f	o	w	■	F	O	W	6
7					■	ï	■	■	g	p	x	■	G	P	X	7
8					ç	ì	Ç	Ì	h	q	y		H	Q	Y	8
9					ñ	β	Ñ	`	i	r	z	■	I	R	Z	9
A					[	]	¦	:	■	ª	¡	¬		¹	²	³
B					·	$	,	#	■	º	¿	┤	ô	û	■	■
C					⟨	★	%	@	■	■	■	¯	ö	ü	Ö	Ü
D					(	)	–	'	■	¸	■	¨	ò	ù	Ò	■
E					+	;	⟩	=	■	■	■	´	ó	ú	■	■
F					!	^	?	"	■	■	■	=	■	■	■	■

	0	1	2	3	4	5	6	7	8	9
0										
1			Note 2					Note 1		
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6			+				â	ä	à	á
7	ã	å	ç	ñ	[	.	<	(	+	!
8	&	é	ê	ë	è	í	î	ï	ì	ß
9	]	$	*	)	;	^	–	/	Â	Ä
10	À	Á	Ã	Å	Ç	Ñ	¦	,	%	_
11	>	?	ø	É	Ê	Ë	È	Í	Î	Ï
12	Ì	`	:	#	@	'	=	"	Ø	a
13	b	c	d	e	f	g	h	i	«	»
14	đ	ý	þ	±	°	j	k	l	m	n
15	o	p	q	r	ª	º	æ	¸	Æ	¤
16	µ	~	s	t	u	v	w	x	y	z
17	¡	¿	Đ	Ý	Þ	®	¢	£	¥	₧
18	ƒ	§	¶	¼	½	¾	¬	|	¯	¨
19	´	‗	{	A	B	C	D	E	F	G
20	H	I	‐	ô	ö	ò	ó	õ	}	J
21	K	L	M	N	O	P	Q	R	ı	û
22	ü	ù	ú	ÿ	\		S	T	U	V
23	W	X	Y	Z	^{2}	Ô	Ö	Ò	Ó	Õ
24	0	1	2	3	4	5	6	7	8	9
25	^{3}	Û	Ü	Ù	Ú					

Decimal representation of characters

Notes:

1. Unprintable character
2. Page advance

Use table from left to right

Examples:
decimal code 193 prints **A**
decimal code 91 prints **$**

The information in this table is used with **CHR$**

Character variables

A character variable is a named item of character data whose value is subject to change during program execution. Character variables are named by a single letter of the alphabet, followed by from zero to seven alphabetic or numeric characters, followed by the dollar sign $.

When the program is executed, the initial value of character variables is set to null (zero length).

When a character expression value is assigned to a character variable, the resulting length of the character variable is that of the expression.

For example:

```
A$="ABC"
```

A$ is now 3 characters long.

The maximum length a character variable can be dimensioned to is 255 characters. Examples of character variables are:

A$
DATA$
NAME$
M211$

The maximum length of a character variable is 18 unless specified in a DIM statement (see "DIM statement").

CHR$(X)

Returns the one-character string occupying the ordinal position X within the native System/23 collating sequence. X must be in the decimal range 0 through 255. If X is outside this range, an error occurs. The change collating sequence Customer Support Function does not affect the result of CHR$. For additional information, see ''Character set.''

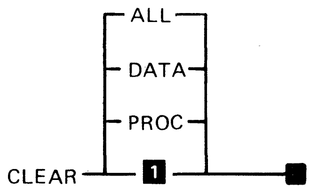
Example:

```
10 X=247
20 A$=CHR$(X)
```

A$ contains ''7''

CLEAR command

The CLEAR command deletes the program or data file from the work area, or cancels the active procedure(s).



1 CLEAR to PROGRAM mode.

The syntax for the CLEAR command is as shown above, where:

ALL clears the work area of the program or data and any active procedure files. In effect, it puts the machine in an initial power-on status.

DATA sets the work area to DATA mode for entering keyboard generated data files. Closes all files (except procedure files) left open by the program in the work area. All contents of the work area are erased.

PROC resets the system to keyboard input and eliminates any active procedure file hierarchy. Closes all procedure files left open. The contents of the work area are not erased.

If no parameter is specified, *PROGRAM* is the default. It sets the work area to PROGRAM mode for program entry. This closes all files (except procedure files) left open by the program in the work area. All contents of the work area are erased.

The status line will display READY INPUT when the command is complete.

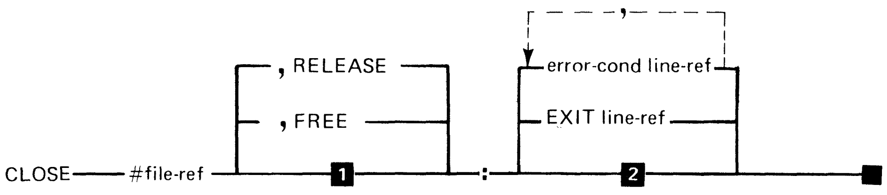
CLEAR should be used whenever a new program is entered. Otherwise, existing lines in the work area may become part of the new program.

Clear display screen

see ''NEWPAGE'' under ''PRINT statement''

CLOSE statement

The CLOSE statement specifies the file to be closed. CLOSE is automatically executed for each active file at the end of program execution.



1 Keep file, maintain reserve status
2 Interrupt on error unless ON is active

The syntax of the CLOSE statement is shown above, where:

file-ref is a numeric expression. See "File-reference parameter."

RELEASE will reset any reserve control status. See "File sharing."

FREE will free the file if it is opened NOSHR. See "DROP/FREE command."

error-cond line-ref specifies the line number or label that the program should transfer to for one of the following error conditions:

IOERR – input/output error
EOF – end of volume

EXIT line-ref specifies the line number or label of an EXIT statement to refer to if an error occurs (see ''EXIT statement'').

Examples

Sample CLOSE statements:

```
20 CLOSE #1:
30 CLOSE #2: IOERR 200
40 CLOSE #3: EXIT CLOSEXT
50 CLOSE #5, FREE: EXIT 400
60 CLOSE #6, RELEASE:
```

Programming considerations

- CLOSE #0 and CLOSE #255
  - CLOSE #0 and CLOSE #255 may be issued even if there was no prior OPEN #0 or OPEN #255.
  - CLOSE #0 and CLOSE #255 may be used to ensure that all screen and printer operations have completed.

- SEQUENTIAL
  - If a DISPLAY I/O file is used for both input and output operations during execution of a single program, the file must be closed and reopened between input and output references.

- Output last data
  - The output file must be closed to make sure that the last records are written. If the diskette is removed without a CLOSE, END, or STOP—data may be lost.

CLOSE statement (continued)

- Extents
  - Any unused portion of the file extents remains assigned to the file after it is closed.

CMDKEY

CMDKEY is a system variable that returns the identity of the last key used to terminate the last INPUT or LINPUT statement.

- -1 is returned if no INPUT or LINPUT was executed in this program.
- 0 is returned if the Enter key was used.
- 1–9 is returned if the Cmd key plus one of the numeric-pad keys was used.

CNT

CNT is a system variable that returns the number of data items successfully processed by the last I/O statement executed. The CNT value is set according to the following:

- CNT is set to 0 before the I/O statement starts executing.
- For INPUT, READ, and PRINT each item is counted as one.
- For LINPUT, the value is set to 1 if data was read.
- For MAT variables, each element is counted separately.

CNT

Example:

```
10 OPTION BASE 1
20 DIM A(4)
30 INPUT MAT A
    •
    •
    • (CNT=4 if successful)
    •
```

Note: CNT should be assigned to a variable if its value will be printed. This is because if used in a PRINT statement, CNT will be reset to 0 before the value of CNT is printed. Continuing the above example:

```
40 X = CNT
50 PRINT X
```

CODE

CODE is a system variable that can be set by the program with a STOP or END statement to any value 0 through 9999. It is available to a procedure for testing with the SKIP command.

Commands

see "System commands"

Comments

See "Remarks"

CON

Sets the entire array to a constant (see "ZER and CON").

Concatenation

Concatenation is joining two or more character strings into one. The symbol used for concatenation is the ampersand (&). For example:

```
10 DIM A$*4
20 DIM B$*3
30 DIM C$*7
40 A$="FLOR"
50 B$="IDA"
60 C$=A$&B$
70 PRINT C$
```

In this example, the character string A$ is concatenated (&) with the character string B$ to form string C$ (FLORIDA).

Another example of how to use concatenation is as follows:

```
10 LET A$="MIKE"
20 LET B$="//1"
30 OPEN #1:"NAME="&A$&B$&",SIZE=0,
             RECL=127",INTERNAL,OUTPUT
40 CLOSE #1:
```

Line 30, above (using concatenation) is the same as line 10, in the following:

```
10 OPEN #1:"NAME=MIKE//1,SIZE=0,
            RECL=127",INTERNAL,OUTPUT
20 CLOSE #1:
```

The result of concatenation must be 255 characters or less. For more information, see "Character expression."

CONTINUE statement

The CONTINUE statement transfers control to the statement following the one causing the most recent ON-condition transfer or I/O exit.

```
CONTINUE ─────────────────■
```

CONTINUE is useful following an ON GOTO transfer or I/O exit. If an ON event is specified to be IGNORED, the return statement specification used by CONTINUE is not changed. See "ON statement".

If a second ON GOTO or I/O exit occurs before CONTINUE is executed, the first occurrence is lost. Avoid operations that cause such occurrences or use ON. . . IGNORE.

If no error has occurred since RUN, execution of CONTINUE causes an error and interrupts execution of the program.

Any event that causes an ON GOTO transfer or I/O exit including the Inq key (ON ATTN), sets the CONTINUE target line.

For a description of special handling of ON events and I/O exits within a defined function, see "DEF,FNEND statement."

COS(X)

Returns the cosine of X, where X is in radians. The absolute value of X must be less than 1E10. For best accuracy specify a value for X greater than - 2*PI or less than 2*PI.

Cross reference

see

''LIST label'' under ''LIST,LISTP command''

Customer Support Functions

The Customer Support Functions are supplied by IBM Marketing Support on diskettes. For detailed information about Customer Support Functions, see *Customer Support Functions, Volume I* and *Volume II*. The Customer Support Functions are:

- Select Machine Update
- Load Machine Update
- Prepare Diskette
- Copy Diskette or File
- Display Diskette Label
- Recover Diskette
- Create Index File
- Change Collating Sequence
- Replace Customer Support Function
- Prepare Sort Control File
- Sort
- List Diskette
- List File
- List Storage

The following Customer Support Functions are part of the Communications Licensed Programs:

- Set Up Asynchronous Communications
- Set Up Binary Synchronous Communications
- Prepare Batch Data Transfer
- Batch Data Transfer
- Asynchronous Communications Terminal
- Diagnostic Analysis
- Online Test

Note: Some Customer Support Functions may be called and controlled from Procedure Files

Select Machine Update—LINK SELECT

The Select Machine Update function creates a file of machine updates to be used by the Load Machine Update function. This must be done before the load machine update features can be performed.

Load Machine Update—LINK UPDATE

The Load Machine Update function is used to load machine updates (supplied by IBM) into the system.

Prepare Diskette—LINK PREPARE

The Prepare Diskette function is used to prepare a new diskette or erase a used one. A new diskette cannot be used as it is received, it must be prepared to the format required by the system.

Customer Support Functions (continued)

Copy Diskette—LINK COPY

The Copy Diskette function does any of the following:

- Copies an exact image of an input diskette to an output diskette
- Copies a group of files from an input diskette to an output diskette
- Copies a selected input file to an output file
- Copies a selected input file or group of files to the printer
- Copies all files from an input diskette to an output diskette
- Compresses files by eliminating deleted records or unused extents

Display Diskette Label—LINK LABEL

The Display Diskette Label function is used to display the contents of the diskette labels for use in recovery procedures. The contents of these labels can also be printed. Labels on any access-protected diskettes cannot be displayed or printed. See "DIR command" and "VOLID command."

Recover Diskette—LINK RECOVER

The Recover Diskette function is used to recover a file when a read error occurs on the label or data portion of the file. The function will save as much of the data on the file as possible. Accidentally freed or dropped files can be recovered even though no read error occurred.

Create Index File—LINK INDEX

The Create Index File function is used to create index files for use in accessing master data file records (see "Key-indexed files").

Change Collating Sequence—LINK COLSEQ

The Change Collating Sequence function is used to replace the memory-resident collating sequence with an alternate collating sequence. It also is used to modify the active collating sequence from the keyboard.

For related BASIC subjects see:

"IF statement"
"AIDX and DIDX"
"OPTION statement"

Replace—LINK REPLACE

The Replace function is used to find obsoleted versions of the Customer Support Functions and replace them with the newer versions.

Customer Support Functions (continued)

Prepare Sort—LINK PRESORT

The Prepare Sort function is used to define the files, sort fields, and other information to be used by the Sort function. This must be performed before the Sort function can be used.

Sort—SORT sort-control-file

The Sort function is used to perform a *Record Out Sort* or an *Address Out Sort*. Record out sort creates a new file with the *records* sorted. Address out sort creates a new file with the address (positions) of the record in the sorted order.

List Diskette—LINK LISTDISK

The List Diskette function provides you with information about the files on the diskette you specify. It provides you with information about the diskette and about the files on the diskette.

List File—LINK LISTFILE

The List File function allows you to investigate the records in a file. It uses your answer to prompts to list records and summary information about the records.

List Storage—LINK LISTSTOR

The List Storage function is a helpful tool that you can use to help you debug a BASIC program. It will print and/or display various parts of storage that were previously saved on diskette using the built-in diagnostic dump. The storage is interpreted in terms of the BASIC program which was resident at the time of the dump.

Set Up Asynchronous Communications — LOAD SETUP.ASC

The Set Up Asynchronous Communications function creates a file containing the communications environment data. This must be done before Communications can be run.

Set Up Binary Synchronous Communications — LOAD SETUP.BSC

The Set Up Binary Synchronous Communications function creates a file containing the binary synchronous communications environment data. This must be done before Communications can be run.

Prepare Batch Data Transfer — LOAD PREBDT

The Prepare Batch Data Transfer communications function builds a control file that directs the operation of Batch Data Transfer.

Customer Support Functions (continued)

Batch Data Transfer — LOAD BDT

The Batch Data Transfer communications function transfers data files to and from a remote system.

Asynchronous Communications Terminal — LOAD ACT

The Asynchronous Communications Terminal function operates as an interactive terminal for asynchronous communications.

Diagnostic Analysis — LOAD DIAG

The Diagnostic Analysis communications function displays trace and statistical information from a communications session.

Online Test — LOAD OLTST

The Online Test function performs Binary Synchronous Communications online tests to verify the communications link.

DATA files

Type 05 (DISPLAY) files are used in the System/23 for procedures, as input to programs (INPUT and LINPUT), and for any other data in the form of keyed input or printed output.

System/23 provides a convenient method of creating, viewing, and editing DISPLAY files. To create a DISPLAY file, enter:

```
CLEAR DATA
AUTO
```

CLEAR deletes any previous data or program from the work area. AUTO puts a line number and colon on the input line. Now enter any desired data, such as procedure file commands or data. All normal editing facilities are available.

When finished, enter:

```
SAVE file-spec
```

This puts the new file on the diskette. Remember to include either a VOLID or device address in the file specification. To edit an existing DISPLAY file, enter:

```
LOAD file-spec, DATA
```

Next, edit the file as usual, then enter:

```
REPLACE
```

For additional information see, ''CLEAR command'' and ''Editing a program.''

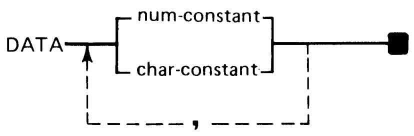
DATA files (continued)

The following BASIC program will print the DATA file (type 05) on the system printer.

```
10 DIM LINE$*255
20 OPEN #1: "NAME=file-spec", DISPLAY, INPUT
30 LOOP: LINPUT #1:LINE$ EOF QUIT
40 PRINT #255: LINE$
50 GOTO LOOP
60 QUIT: STOP
```

DATA statement

The DATA statement creates an internal data table. The data table constants are assigned to the variables and/or array elements by the READ statement (see "READ statement").



The syntax of the DATA statement is as shown above, where:

num-constant is any numeric value (see "Arithmetic constant" under "Arithmetic data").

char-constant is any character string value. The character string may be quoted or unquoted. In the quoted character string, any characters are allowed. In the unquoted character string, leading and trailing blanks are ignored, commas and quotes are not allowed.

When program execution begins, a pointer is set to the first constant in the table. The pointer is advanced as data is read by the READ statement. (The RESTORE statement may be used to restore the pointer to the first constant.)

DATA statement (continued)

Example

```
100 OPTION BASE 1
110 DATA "DEBIT",21.60,"CREDIT",15.40
120 DATA MONTH, DAY, YEAR
130 READ A$,N,B$,C
140 DIM Z$(3)
150 READ MAT Z$
```

Programming considerations

- Location
  - The DATA statements may be placed anywhere in the program regardless of the position(s) of the READ statement(s).

- Too few values
  - If the DATA statement does not contain enough constants for the READ statement issued, an EOF error is generated.

- Character data
  - Character data does not have to be enclosed in quotation marks unless leading blanks, embedded commas, or lowercase characters are significant. Unquoted lowercase letters and graphic characters are converted to uppercase.

- Numeric data
  - Numeric values may be accessed and read as either a numeric or character value.

- Remarks
  - A remark is not permitted on DATA statements. It is interpreted as part of the data.

DATE command

The DATE command assigns the specified date to the system variable DATE$.

```
DATE——yy/mm/dd——■
```

The syntax of the DATE command is shown above, where:

yy is in the range 00 to 99
mm is in the range 01 to 12
dd is in the range 01 to 31

An example of the DATE command with a remark is:

```
DATE 81/01/01 ! Happy New Year
```

DATE$

DATE$ returns an eight character string that is set by the DATE command. At power-on, it is set to (ƀƀ/ƀƀ/ƀƀ).

The date is *not* updated by the system.

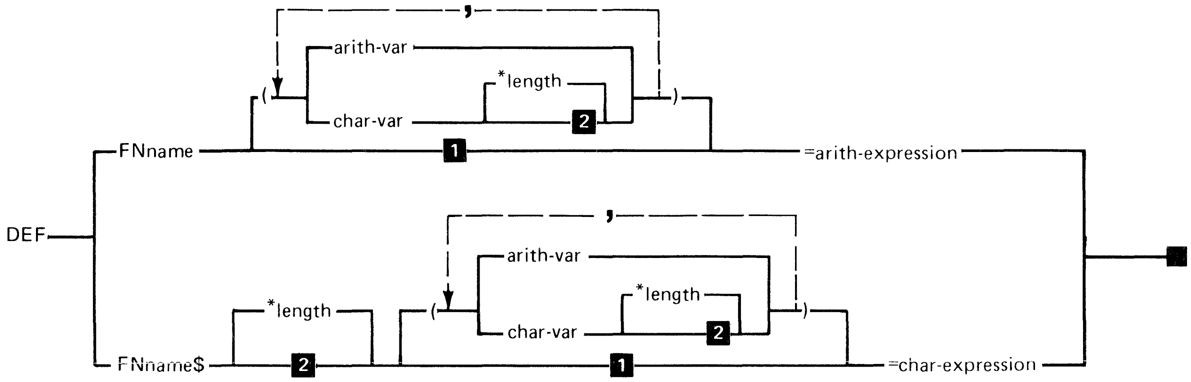
Declaring arrays

see "DIM statement"

DEF,FNEND statement

The DEF statement is used to define an arithmetic or character valued function for reference elsewhere in the program. The FNEND statement indicates the end of a multiple-line function. The syntax of the DEF statement can be either a one-line or multiple-line function.

One-line function



■1 No input parameters
■2 Length is 18

The syntax for the one-line function is shown above, where:

FNname is any valid variable name. This name, preceded by the letters FN is the name of the defined function. For character valued functions, this name must be followed by the dollar sign $.

length is the length of the character variable used as input or output. The length may range from 1 to 255 characters.

arith-var is an arithmetic variable name to which a value will be assigned when the function is called.

char-var is a character variable name to which a value will be assigned when the function is called. Values assigned to the character variable cannot exceed the maximum length of the variable. Loss of data will result.

arith-expression is an arithmetic expression that specifies the value to be returned for the function. If the function name is an arithmetic variable, an arithmetic expression must be specified. See ''Arithmetic expressions.''

char-expression is a character expression that specifies the value to be returned for the function. If the function name is a character variable, a character expression must be specified. See ''Character expressions.''

Example one-line DEF statements

Arithmetic function:

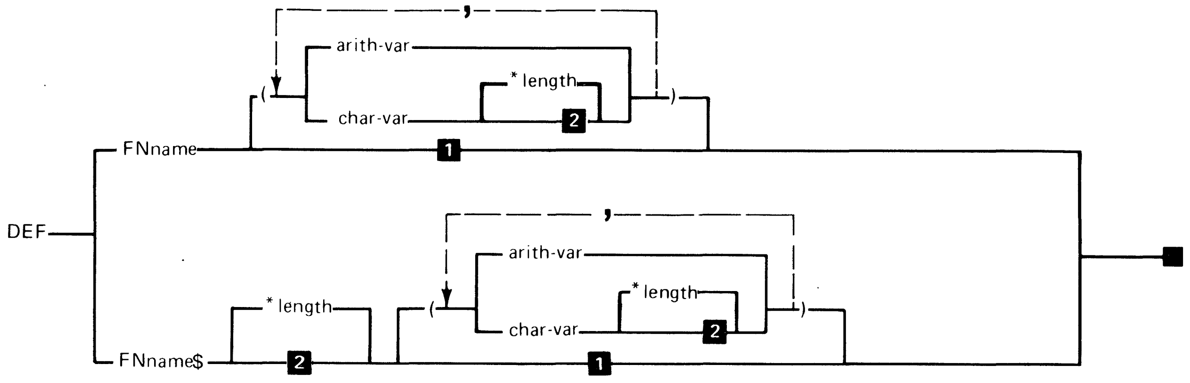
```
120 DEF FNA(R)=2*R+100
```

Character function:

```
120 DEF FNA$(R)=STR$(R+5)
```

DEF,FNEND statement (continued)

Multiple-line function



1 No input parameters
2 Length is 18

The syntax for the multiple-line function is shown, where:

FNname is any valid variable name. This name, preceded by the letters FN, is the name of the defined function. For character valued functions, this name must be followed by the dollar sign ($).

length is the length of the character variable used as input or output. The length may range from 1 to 255 characters.

arith-var is an arithmetic variable to which a value will be assigned when the function is called.

char-var is a character variable to which a value will be assigned when the function is called. Assigned values for the character variables cannot exceed the maximum length of the variable.

The LET statement assigns the value of an expression as the result of the function.

The FNEND statement is descriptive and indicates the end of a multiple-line function. The value of the function is specified in an expression in the LET statement.

Example multiple-line DEF statement

```
10 LET A = 5
20 LET B = 2
30 LET C = -5
40 DEF FNA(X,Y)
50 IF X > 0 THEN LET FNA = X+Y ELSE LET FNA =X-Y
60 FNEND
70 LET D = FNA(A,B)
80 LET E = FNA(C,B)
90 PRINT D,E
```

In this example, when these statements are executed, D will have a value of 7 and E will have a value of -7.

The use of functions

When a user function reference appears in an executable BASIC statement, any expressions that follow the function name must be separated by commas and enclosed in parentheses. These expressions are evaluated and passed by the system to the user function in order to initialize the corresponding variables in the DEF statement. These values must agree in number, length, and type with the

DEF,FNEND statement (continued)

corresponding variables in the DEF statement. If the DEF expression is present, the function is defined on the same line and its value is the value of that expression. This is a one-line function. If no expression is specified in the DEF statement, the DEF statement is the start of a multiple-line function. In this case, the FNEND statement indicates the end of the function and the value of the function is specified by the value of the variable FNname assigned in the LET statement.

Programming considerations

- Use of functions
  - A function reference to a user-defined function may appear anywhere in a BASIC program that a constant, variable, subscripted array element reference, or system function reference can appear (see "Arithmetic expressions").
- Location
  - A function can be defined anywhere in a BASIC program either before or after it is referenced.
- Name localization
  - The variables named in the DEF statement are local to the function. Consequently, it is possible to have a variable in the DEF statement with the same name as a variable used elsewhere in the program. Each variable is recognized as being unique, and no conflict of names or values results from this duplicate usage. All variables which are not DEF arguments have the same value/meaning for all statements.

- On CONDITION localization
  - When execution of a multiple-line defined function begins, all ON CONDITION settings are stacked and set to SYSTEM. New settings for the ON CONDITION may be specified within the function. If an ON event occurs within the function and the specification is IGNORE, it will be ignored. If the specification is GOTO, the transfer will occur, and the function will remain active. CONTINUE and RETRY will return execution to the appropriate line within the function. If SYSTEM is active, the function execution is abandoned. The ON conditions are unstacked and whatever was specified for the event preceding the current function will occur (IGNORE, SYSTEM, GOTO).

DEF,FNEND statement (continued)

- Bypass function
  - After control is passed to a DEF statement without reference to the function, control goes to the first executable statement following the function definition (the DEF statement for one-line functions, or the FNEND statement for multiple-line functions).
- Cmd/Attn
  - If Cmd/Attn is pressed during the execution of a defined function, execution will be interrupted. If Error Reset is pressed, execution of the function will resume normally. If Cmd/Error Reset is pressed the function is abandoned and the system enters split screen mode at the line which invoked the defined function.
- I/O exits
  - Exit clauses specified in I/O statements within a multiple-line defined function causes the specified transfer of control when the event occurs. The function remains active and CONTINUE and RETRY will return to the appropriate line within the function.
- Inq
  - If the Inq key is pressed during execution of a defined function, it is ignored until all currently executing defined functions have completed execution. At that time whatever ON action specified, prior to entering the function, occurs. (IGNORE, SYSTEM, GOTO).
- Single definition
  - A function of a given name can be defined only once in a given program.

- Recursion
  - A function cannot contain references to itself or to other functions that refer to it.

- FOR/NEXT
  - A FOR/NEXT loop beginning in a function must also end in the same function.

- Nesting
  - DEF function definitions cannot be nested.

- Input/Output
  - User-defined functions that are referred to during an input or output operation cannot themselves perform any input or output operation.

- Modification of variables
  - If a function definition alters the value of a variable that is referenced in the same statement that calls the function, the results may not be as expected.

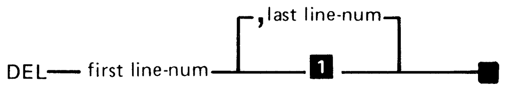
- Termination
  - A program may not be terminated when a defined function is still in execution. An FNEND must be issued for each invoked DEF before program termination.

- EXIT and FORM
  - EXIT and FORM statements inside a multiple-line DEF function can be referenced from outside the function; those outside the function can be referenced from inside a DEF function.

- Be sure that the first line of a multiple-line function (DEF) is not the last line of the program.

DEL command

The DEL command is used to delete one or more consecutive lines from a BASIC program or DATA work area.



1 Delete only one line number

The syntax of the DEL command is shown above, where:

first-line num is a number specifying the first line number of several consecutive line numbers to be deleted. It may also be the only line number to be deleted.

last-line num is a number specifying the last line number of several line numbers to be deleted.

The numbers used in the first-line and last-line numbers must be integers in the range of 1 through 99999. The first-line number must be less than the last-line number.

No additional storage becomes available as a result of using the DEL command. The additional storage will become available when the program is SAVEd in SOURCE format and LOADed.

Example

To delete line 20 from a program or data work area:

```
DEL 20
```

To delete lines 20 through 90 from a program or data work area:

```
DEL 20,90
```

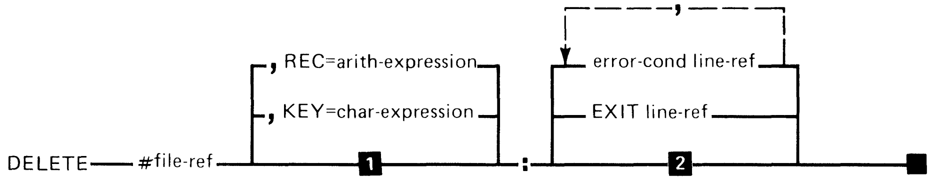
If line 20 or 90 does not exist in the workspace, then the range of lines that do exist between 20 and 90 will be deleted. If no line exists, an error is presented.

Programming considerations

- Comments should not be used on the DEL command.

DELETE statement

The DELETE statement deletes either the last record read from the file or the record specified by the position specification. After the record is deleted, the file is positioned to a location immediately following the deleted record.



1 DELETE last record accessed READ/REREAD
2 Interrupt on error unless ON is active

The syntax of the DELETE statement is shown, where:

file-ref is a numeric expression (see "File reference parameter").

REC=arith-expression specifies that the record having a record number equal to the arithmetic expression is to be deleted.

KEY=char-expression specifies that the first record in the file having a key equal to the character expression is to be deleted.

error-cond line-ref is the error action for one of the following: NOREC, IOERR, or NOKEY

For information on the error actions see "EXIT statement".

EXIT line-ref specifies the line number or label of an EXIT statement to refer to if an error occurs.

Example

A sample DELETE statement is shown here:

```
80 A$="ZEPOL"
90 DELETE #8, KEY = A$:
```

In this example, the first record with a key field equal to ZEPOL is deleted.

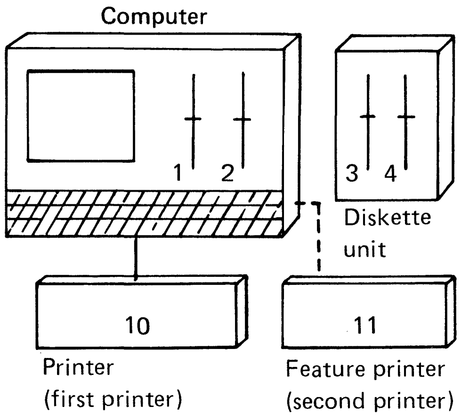
Programming considerations

- The file must have been opened as INTERNAL, OUTIN. The file organization may be SEQUENTIAL, RELATIVE, or KEYED.
- The SEARCH parameter is not permitted.
- If no KEY or REC parameter is specified, the previous access to this file must have been a successful READ or REREAD statement.

Descending index (MAT assignment)

see "AIDX and DIDX"

Device address parameter



Many BASIC statements and system commands require entry of a device address parameter. This address identifies the input/output device being used. Valid device addresses (in decimal) for System/23 are:

1	Diskette drive 1
2	Diskette drive 2
3	Diskette drive 3
4	Diskette drive 4
10	Printer
11	Feature printer
40	Communications

See ''OPEN statement'', ''File specification parameter''.

Device sharing

Device sharing means that two 5322 Computers are connected to the same 5246 Diskette Unit and both have different open files on the 5246. This situation is handled entirely by the system and never produces any new logical or data integrity questions.

The 5246 can only service one computer at a time and thus each computer may experience additional waiting time when the other computer is already using the 5246. For this reason, only data that is to be shared by both computers should be located on the 5246. Files which are to be used only by one of the computers should be located on that computer's inboard drive.

During the computer power up testing, an attempt is made to access the 5246 to establish its presence and the computer work station identification (WSID$).

Device sharing

- If the 5246 is in use by the other processor, +0 will appear on the status line. In this case the operator may simply wait for the 5246. If the operator does not wish to wait, then he may press Cmd/Attn, producing an action code 21 and error code 6009. ERROR RESET will now return the processor to waiting for the 5246.

  Cmd/Error Reset will terminate the wait. The 5246 is now logically detached from the processor and all future references to it will cause an error 4153 (device not attached). To attach the 5246 you must now power the processor down and up again, with the 5246 power on.

- If the 5246 is not powered on, action code 21, error code 6009 is displayed. To attach the 5246, power it up and press Error Reset. If the 5246 is not plugged in or has a blown fuse, action 21, error 6009 will reappear. To ignore the 5246, press Cmd/Error Reset.

The state of the shared 5246 is indicated on the status line in columns 53 and 54 by the following codes:

- blank – The 5246 is not required by this processor.
- +0 – The other processor is currently using the 5246, or the 5246 was powered up before the processor but is now powered down; this processor is waiting to use it. If the 5246 is powered on and you wish to wait for it, ---DO NOTHING---.
- +1 – This processor is now using the 5246.

When the processor is waiting to use the 5246 (+0), the operator may interrupt this wait with Cmd/Attn. To continue with the original operation, press Error Reset. To terminate the current operation with I/O error 6009 or

Device sharing (continued)

6011, press Cmd/Error Reset. The latter action would be used to terminate a program (with GO END) or command if the other processor will continue using the 5246 for a long time.

If the program has open files when you do this, data may be lost.

For some operations, multiple I/O accesses may be attempted following the interrupt of the +0 wait. After the first Cmd/Attn, Cmd/Error Reset cycle, another +0 may appear. Continue with the Cmd/Attn, Cmd/Error Reset cycle until the +0 is cleared.

Share and Reserve status may be left on for the file which was being accessed. Use the PROTECT command to remove them.

If the operator presses Hold while +1 is displayed, this prevents completion of the current 5246 access and prevents the other processor from accessing it.

The 5246 is also unavailable for the duration of an action code 10 (waiting for diskette to be inserted), if drive 3 or 4 or no drive is given in the file specification. This will also occur if the diskette contains an open file, the diskette has been removed, and is now required.

Each of the two cables connecting a processor to the 5246 identifies the connected processor with respect to the use of the 5246. This identification is provided through the WSID$ system variable.

If the processor is connected to cable 1, or is not attached to the 5246, or the 5246 power was off during the processor power up, then WSID$="01".

If the processor is connected to cable 2 and the 5246 was powered up before the processor, then WSID$=''02''. WSID$ is useful in establishing unique file names when the same application is running in both processors.

The following Customer Support Functions secure the 5246 for the entire duration of their execution:

- Prepare Diskette
- Copy Diskette (image copy only)
- Recover Diskette
- Display Diskette Label

See also ''File sharing'' for information on the simultaneous use of the same file by two different OPENs.

DIDX (array name)

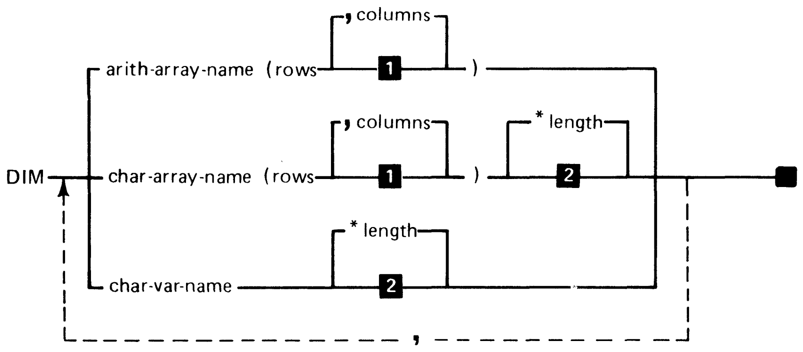
Returns an array containing the descending index of the source array. See ''AIDX and DIDX''. Also see ''OPTION statement'' (COLLATE).

Dimensioning arrays

see ''DIM statement''

DIM statement

The DIM (dimension) statement specifies the maximum size of arrays and character variables, and their original dimension.



1 One-dimensional array (vector)
2 Defaults to length of 18

The syntax of the DIM statement is shown above, where:

arith-array-name is an arithmetic array to be dimensioned.

char-array-name is a character array to be dimensioned.

char-var-name is a character variable to which a length will be assigned.

rows and columns are integers specifying the dimensions of the arrays (highest subscript(s)). One dimensional arrays require only the row entry. Two dimensional arrays require both the row and column entries separated by a comma. For example:

```
10 DIM A(20,25)
```

length is the maximum length of a character scalar, or the maximum length of each element of a character array. This value may be from 1 to 255. If length is not specified, the default maximum length is 18 characters.

The initial value of each arithmetic array element is zero. Each character array element is initialized to null (zero length). This initialization takes place when the array is first referenced.

Declaring arrays

Arrays can be declared either by using the DIM statement or by a reference to an element of an array that has not been declared.

When an array is declared by using the DIM statement, the dimension and maximum number of data items are specified in the DIM statement. For example:

```
20 DIM A(10)
30 DIM WEEK$(6)*9
```

Statement 30 dimensions array named WEEK$ to use the seven array elements WEEK$(0) through WEEK$(6). The maximum length of each element is 9 characters.

If OPTION BASE 0 is in effect, statement 20 dimensions the array named A to use 11 array elements A(0) to A(10).

When an array is declared by a reference to one of its elements, it is one- or two-dimensional based upon its use and has 10 elements in OPTION BASE 1 and 11 elements in OPTION BASE 0. For more information see "OPTION statement." For example:

```
40 A(3) = 50
```

establishes a one-dimensional array containing 10 elements, if OPTION BASE 1 is in effect, the third element A(3) has an integer value of 50, and the remaining elements have values of zero.

```
50 WEEK$(0)="Sunday"
60 WEEK$(3)="Wednesday"
```

Arrays requiring more than 10 elements (BASE 1) or 11 elements (BASE 0) must be declared explicitly.

An array can be declared by a DIM statement only once in a program.

If an array or character variable is passed as a parameter by the CHAIN statement, it must be declared in a DIM statement in both programs, and the same size must be specified.

For more information see:

- "Character arrays"
- "Arithmetic arrays"
- "Substring referencing"

Example

A sample DIM statement is shown:

```
10 OPTION BASE 1
20 DIM A$(5)*20,B(4,2)
30 LET X = LEN(P$) ! x is 0
40 LET P$= "ABCDEFGHIJKLMNOPQR"
```

The result of the DIM statement is:

A$ is a character array with five elements (one-dimensional array), each has a maximum of 20 characters. All five elements are initialized to zero length.

B is an array of four rows and two columns (two-dimensional array).

P$, which is not declared in any DIM statements defaults to a maximum of 18 characters and is intialized to zero length. Statement 40 above changes it to length 18.

DIM statement (continued)

Programming considerations

- Redimensioning
  - If a user wants to change the size of an array during execution time, redimensioning can be used. However, the array is allocated to its full DIMensioned size when first referenced. The storage will be reused when redimensioning occurs. Another technique is to create a procedure file to edit a DIM statement into the program. For example:

    ```
    LOAD file-spec
    10 DIM A$(59)*33
    RUN
     •
     •
     •
    ```

    see "Redimensioning"

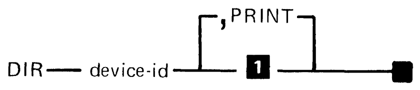
- *Zero
  - If a length of 0 is specified, it is interpreted as the default length of 18.

- Duplicate DIM
  - An array or character variable cannot appear in a DIM statement if it has been defined in another DIM statement.

- The maximum value that can be specified for row or column is 9999. If sufficient storage in the work area is available, the maximum size of an array is 65534 (see "Storage use").

DIR command

The DIR command lists a directory of file information. Information about each file is printed or displayed on one line per file.



1 Displays the directory on the screen

The syntax of the DIR command is shown above, where:

device-id specifies which diskette drive is to have its files listed. The devices are 1, 2, 3, and 4 (see ''Device address parameter'')

- Diskette drive 1
- Diskette drive 2
- Diskette drive 3
- Diskette drive 4

PRINT specifies that the listing be printed (device address 10).

The listing can be interrupted by pressing the Hold key once. To continue with the listing press the Hold key once again. To terminate the commands press the Cmd/Attn key. Since printer operations overlap other System/23 operations, after pressing the Cmd/Attn key, the printer will print the data remaining in the print buffer.

DIR command (continued)

Example

The following information is displayed about each diskette.

1	The VOLID (volume identification) of the diskette
2	The diskette type (1, 2, 2D)
3	The number of bytes not used by files on diskette
4	The number of available files
5	The number of defective sectors
6	The physical record size

Additionally for each file on the diskette, DIR will display:

7	File type (see "Diskette file types")
8	filename (see "File specification parameter")
9	Number of bytes allocated to the file
10	Number of bytes of data in the file
11	The number of extents in the file
12	Protective information; P means protected, Read only allowed

The following are File Sharing Status:

13	Station 1 Open status
14	Station 1 Reserve status
15	Station 2 Open status
16	Station 2 Reserve status

```
dir 1

   1     2    3      4    5    6
CONKLN  2D 0910336 0046 0000 512
05 AUTO              0001024 0000512 0001
05 FAIRWAY           0003072 0003072 0005
05 FSP.SOURCE        0001536 0001024 0001
09 ANIMATE           0008192 0007168 0001
05 PROC1             0000512 0000512 0001
05 DEMO              0000512 0000512 0001       ISI
07 FILE.IND          0000512 0000512 0001
05 CH                0002048 0001024 0001
05 MAKE.SCREEN.SRCE  0002048 0001024 0001
04 NEWFILE           0004096 0000972 0001  P
05 SCREEN1           0004096 0002048 0001
05 NEWINDEX          0000512 0000512 0001
05 FSP.TEST          0004096 0001024 0001
05 BUILD.MURPHY      0001024 0000512 0001
05 MURPHY.FIX        0004096 0001024 0001                OSH  OSH
05 MURPHY 0003584    0002048 0001024 0001           ISH
04 MURPHY.FILE       0025088 0024920 0001
04 SCREEN.FILE       0020480 0020480 0001       NS
05 SCREEN            0002560 0001536 0001
 7    8                 9       10     11  12    13  14    15   16
```

NS – opened no share
ISH – opened for input, SHR
ISI – opened for input, SHRI
OSH – opened for output, SHR
OSI – opened for output, SHRI

DIR command (continued)

The preceding information is displayed for System/23 type diskettes (type Z) and BX and HX diskettes. For diskettes containing BX or HX files, the volume information (first line) will contain only VOLID, diskette type, and physical record size. File information will not contain sharing or reserve status. If other diskettes conforming to IBM diskette data format are used, only the VOLID and FILEID are accurate. The rest of the information will be unpredictable.

For related information see:

"File sharing"
"PROTECT command"
"OPEN statement"
"FREESP"
"Prepare diskette" under "Customer Support Functions"

Diskette data buffering

The term *buffering* means storing data in an intermediate storage area when coming or going to an I/O device.

The System/23 reserves sufficient storage to perform any valid I/O operation, once the file has been OPENed. Substantial improvements in performance can be realized by allowing (or adding) additional storage which can be committed to the OPEN operation. This allocation is handled automatically by the System/23 whenever storage is available. If the size of your program does not permit this allocation, it will still function correctly, but slower.

The maximum space used in this allocation is 512 bytes for each file that:

- is an index file
- has more than one extent (see ''DIR command'')

An additional allocation is made for files that are open as:

- DISPLAY,INPUT
- DISPLAY,OUTPUT
- INTERNAL,INPUT,SEQUENTIAL
- INTERNAL,OUTPUT,SEQUENTIAL
- PROC
- SUBPROC

The size of this allocation is the minimum of the following:

- 7680 bytes for type 2D diskettes and 4096 bytes for type 1 and 2 diskettes
- The extent size to be read
- The value of the SIZE= parameter on the OPEN for output of the file.

Diskette dynamic file extension

The creation of a System/23 type file requires the specification of an initial amount of space to be allocated to the file. The OPEN statement obtains this value from the SIZE parameter. (The SAVE command computes this value based upon the approximate size of the workarea to be saved.) If at any time additional space is required because the original specification was too small, System/23 will automatically add additional space (called ''extents'') to the file (except as noted below and in ''Diskette file size''). Each additional extent is 10% of the initial allocation rounded up to the next increment of 512. Up to 99 extents can be added to a file. If even more space is required, the file must be copied by the Copy Customer Support Function into fewer extents.

Note: If FORMAT=BX or HX is specified on an OPEN INTERNAL statement, the file created will not be extended beyond its initial allocation.

See also ''DIR command'' ''Diskette data buffering'' ''OPEN statement'' ''Diskette file size''

Diskette file searches

When an OPEN (or implied OPEN) is executed, the file that is OPENed depends on the file specification and the location of the diskette.

- File name only .. file

  The search begins on drive 1 and continues on successively higher drive numbers. The first match is assumed to be the correct file. If other files of the same name exist on other diskettes, they are ignored. If not found, error 4000 is reported on the status line.

- File name and drive ID .. file//drive

  The search occurs on the specified drive only. If not found, error 4000 is reported on the status line.

- File name and VOLID .. file/VOLID

  The search is done on the lowest numbered drive with the specified VOLID inserted.

- File name and VOLID and device .. file/VOLID/drive

  The search occurs on the specified drive if the VOLID matches. If the VOLID matches and the file is not found, error 4152 is returned. If the VOLID does not match, error 4000 is reported on the status line. If the file/VOLID/device specification matches that of an open file, the *found* file must be marked OPEN for the new OPEN to succeed. That is, you cannot open two different files with the same file/VOLID/device specification.

Diskette file searches (continued)

Note the following implications:

- If duplicate VOLIDs are inserted, the one mounted in the lower numbered drive is accessed in the absence of a drive specification.

- If offline data (see ''Offline diskette files'') is involved in the application, and open files exist on diskettes with the same file name and VOLID, unpredictable results can occur.

- The simplest and safest course is to code all file specifications with file name and VOLID and use unique file names and VOLIDs.

Diskette file size

The following can be used to estimate the diskette storage used by various file types. See "OPEN statement, SIZE= parameter".

Type	Size (bytes)
BX	128 per record
HX	256 per record
04	(1+RECL) per record
05	Total number of characters including blanks and new line characters
07	512 * CEIL (number of records/(INT(512/(key length+4))-1))
08	Value for type 07 plus 512 * CEIL (number of new records /INT(510/(key length+10)))
09	(HELP STATUS size at CLEAR) - (HELP STATUS size when SAVEd) + (up to 2048 bytes)

Diskette file size (continued)

All files are automatically extended for additional output, except:

- Type BX and HX which are fixed at OPEN to the SIZE value
- Files on diskettes with no unallocated space; see "DIR command"
- Files with 100 extents; see "DIR command"

The following chart shows the maximum file size, in bytes, for each combination of diskette type and diskette format:

	Diskette format		
Diskette type	**System/23**	**BX**	**HX**
1	301,568	242,944	n/a
2	604,672	485,888	n/a
2D	1,135,104	n/a	985,088

Diskette file types

The following table details the various diskette file types processed by System/23.

File type	Contents/ description	Created by	Record length	Input	Output	Access mode	Recoverable
BX	Basic Exchange	OPEN INTERNAL Format = BX	RECL= 1 to 128	READ	WRITE	SEQ.	Yes (Note)
HX	H Exchange	OPEN INTERNAL Format = HX	RECL= 1 to 256	READ	WRITE	SEQ.	Yes (Note)
04	Data	OPEN INTERNAL Format = Z	RECL= 1 to 4096	READ	WRITE	SEQ/REL KEYED	Yes (Note)
05	Data	OPEN DISPLAY SAVE SOURCE SAVE (data)	variable 0 to 255	PROC INPUT LINPUT LOAD [DATA]	PRINT REPLACE SAVE SOURCE	SEQ.	Yes (Note)
07	Index file without overflow area	Index GEN Create index file		READ KEY		KEYED	
08	Index file with overflow area	Index GEN OPEN KEYED OUTPUT		READ KEY	WRITE KEY	KEYED	No
09	Program file (internal)	SAVE		LOAD	SAVE REPLACE		No
10	Customer Support Function	IBM		LINK			No
11	Feature	IBM		LINK			No
12	Machine update	IBM		SELECT UPDATE	SELECT		No
13	Diagnostics	IBM		CE diagnostic			No

Note. To recover use Recover Diskette (Customer Support Functions).

DISPLAY

Display files and data

Display, as a type of data, refers to the input and output of data that can be printed or displayed. This includes transfer of data from/to devices such as the keyboard, display, printer, and diskette. While DISPLAY I/O may be performed to or from diskette files, data is transferred in a format similar to that for display devices. The same format is used for BASIC source programs and procedure files on a diskette.

Display files are accessed by:

- CLOSE (optional for diskette and system printer)
- INPUT
- LINPUT
- LOAD (SOURCE or DATA)
- OPEN (DISPLAY) (optional for diskette and system printer)
- PROC
- PRINT
- REPLACE (SOURCE or DATA)
- RESTORE
- SAVE (SOURCE or DATA)
- SUBPROC

Example

This example directs program output to a selected device.

```
 10 PRINT "Choose one:"
 20 PRINT "  1  Printer output"
 30 PRINT "  2  Feature printer"
 40 PRINT "  3  Diskette output"
 50 INPUT CHOICE
 60 IF CHOICE = 1 THEN FILEID$ = "//10"
 70 IF CHOICE = 2 THEN FILEID$ = "//11"
 80 IF CHOICE = 3 THEN FILEID$ = "SAVE.REPORT//1,
    SIZE=0"
 90 N$ = "NAME="
100 OPEN #1: N$&FILEID$,DISPLAY,OUTPUT
110 PRINT#1: "First line of report"
  •
  •
  •
500 CLOSE #1:
```

If the operator keys a 1 in response to INPUT statement 50, the output is directed to the system printer. If 2, the output is directed to the feature printer. If 3, the output is directed to the diskette.

DISPLY (X)

DISPLY returns the value (1-5) of the current character group for the display. The X parameter, which is optional, is used to set the new page (see ''Character set'').

1	U.S.A.
2	Canada
3	Europe, except Spain
4	Nordic, including Iceland
5	Spain, Spanish speaking countries

DROP/FREE command

The DROP command is used to set a file to the empty state, which sets the end of data pointer equal to beginning of file. The file space remains allocated.

The FREE command specifies that the file space reserved for the file is to be freed and may be allocated to another file. The file is no longer accessible after a FREE command.

For more information, see "Recover diskette" under "Customer Support Functions" and "CLOSE statement".

Data is not modified on the file by either the DROP or FREE command. If security is required, the file may be written over by a BASIC program previous to the DROP or FREE command.

```
DROP——file-spec————■
```

```
FREE———file-spec————■
```

The syntax of the DROP/FREE command is shown above, where:

file-spec is the file name, optionally followed by the volume-id, or device-id (see "File specification parameter"). The file must not be OPENed when DROP or FREE is issued and must not be reserved by the other station in a dual-station System/23.

DROP/FREE command (continued)

Use FREE if you want to change the record length of an INTERNAL file.

Use the Copy Diskette function to compress unused space from the file (see "Customer Support Functions").

Any attempt to DROP an index file will cause an error; use FREE.

Example

```
FREE FILEA
```

Editing a program or data file

Adding statements

You can add statements simply with the line number followed by the statement at any time while your program is in the work area. The following cannot be added while a program in execution is interrupted: DIM statement, OPTION statement, FOR statement, and NEXT.

Changing line numbers

You can change the line numbers in a BASIC program by entering the RENUM command. RENUM changes the line numbers to 00010, 00020, 00030, etc. See "RENUM."

Deleting statements

Enter DEL followed by a line number, or DEL followed by the first and last line numbers of consecutive statements. See "DEL command."

Replacing statements

You can replace one statement with another by entering the new statement using the same line number. You can enter it by editing the old line or entering a new line. The following statements cannot be changed while a program in execution is interrupted: DIM, OPTION, FOR, and NEXT.

Editing a program or data file (continued)

Several commands and BASIC statements can be entered by using the Cmd key and a special key. You should refer to your *Keyboard Aids* and "The keyboard" in your *Operator Reference* manual for a complete list of special keys.

Programming considerations

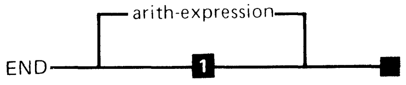
- Editing does not reduce the size of the program.
- If extensive editing is performed, the work area may fill up and an error will occur; save the program in source format, then load.
- If a label is deleted, its absence will not be detected until it is referenced at execution time.
- If the program exists on a file, do a REPLACE (see "REPLACE command").
- Editing the line following a GOSUB while a program in execution has been interrupted may cause unexpected results when program execution resumes.

ELSE

see "IF, THEN, ELSE statement"

END statement

The END statement specifies the end of a BASIC program and ends program execution. If the END statement is not specified, the system will still perform the END functions as if one were specified at the end of the program.



1 Code is set to 0

The syntax of the END statement is as shown above, where:

arith-expression is the numeric value from 0 to 9999 which, after rounding, sets the CODE variable (see "CODE").

Execution of the END statement closes all open files and ends the program. The actions of the END statement are identical to those of the STOP statement.

Examples

```
910    END        !Value of CODE = 0
910    END 120    !Value of CODE = 120
```

Programming considerations

- Location
  - The END statement, if specified, must be the last statement of the program.

END statement (continued)

- CODE default
  - If the optional arith-expression is not specified, the default value of CODE is zero.

ERR

ERR is a system variable that contains the number of the most recently detected error (see ''PROCERR command'' and ''System/23 Messages Manual'').

Error handling

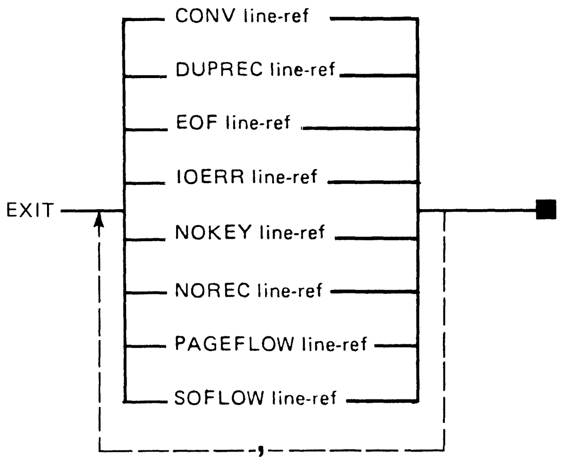
see ''EXIT statement''
''Interrupt''
''System variables''
''ON statement''
Customer Support Functions, Volume I and *Volume II*
System Messages

Execution order

see ''Order of execution''

EXIT statement

The EXIT statement specifies where control will be transferred if an error occurs. The EXIT statement is descriptive and serves as a guide to the program. It indicates the line reference to which program control will transfer if an error occurs. The EXIT statement is referenced by an EXIT parameter on an input/output statement. When an error occurs, the EXIT statement is referenced. Program control will transfer to the line reference associated with the error condition.



The syntax of the EXIT statement is as shown above, where:

CONV, DUPREC, EOF, IOERR, NOKEY, NOREC, PAGEOFLOW, and SOFLOW are error conditions for the various input/output statements.

CONV indicates a conversion error. There are four types of conversion errors:

EXIT statement (continued)

- The I/O list item (numeric versus character) does not match the type of the FORM data conversion specification

- A numeric I/O list item will not fit within the field length specified in the FORM data conversion specification

- A numeric input field contains non-numeric data

- A negative value is being output, the corresponding PIC data conversion specicification does not contain a specifier for the sign.

DUPREC this error indicates that a record with the same relative record number already exists in the file referenced in the WRITE statement.

EOF this error indicates end of file:

- For a READ or INPUT statement. There are no more records in the file.

- For a PRINT or WRITE statement. There is not enough file space for the data.

IOERR for all input/output statements, this error indicates that an error has prevented completion of the statement which is not one of the other error conditions.

NOKEY this error indicates that no key matching the specified key can be found in the referenced file.

NOREC this error indicates that the specified relative record number is two or more greater than the relative number of the last record in the file or points to a deleted record.

PAGEOFLOW this condition indicates that the line printed is greater than or equal to (>=) the PAGEOFLOW value set in the OPEN statement (see "OPEN statement").

SOFLOW this error indicates that the number of input data characters is greater than the length of the I/O list character variable, or conversly, the length of the output I/O list character expression is greater than the field width defined in the FORM data conversion specification.

line-ref is a line number or a label symbol

EXIT	Description	Value of ERR
CONV	Conversion error	0002 0726
SOFLOW	String overflow	0004 0058
DUPREC	Write to existing record	0054
NOKEY	No key found	4272
NOREC	No record found	0057
PAGEOFLOW	Page overflow	0701
EOF	Not enough data items for READ	0054
	End of file	4270
	End of volume. No data space available to extend output file	4239
	No extents. Maximum number of extents assigned. Cannot extend output file	4271
IOERR	All other errors that occur on I/O statement	See Messages Manual

EXIT statement (continued)

Example

An EXIT statement is shown below:

```
80 EXIT EOF 200, IOERR 220, NOKEY 240, NOREC 260
```

In this example, an input/output statement referencing line number 80 for the EXIT parameter will cause program control to transfer to line number:

- 200 if an EOF condition caused the error
- 220 if an IOERR condition caused the error
- 240 if the key specified could not be found
- 260 if the record specified could not be found

Programming considerations

- Duplicate EXIT
  - Error conditions can be entered in any order. If a duplicate specification appears, it is ignored; the first one will be used.

- Arithmetic errors
  - Overflow, underflow, and zero divide conditions that are detected during the evaluation of an arithmetic expression cannot be trapped by exits on I/O statements. These conditions can be trapped using the ON statement.

  Note: If an I/O list item is being mapped into a PIC data conversion specification, this rule is overridden. The overflow, underflow, or zero divide can be trapped by IOERR on the I/O statement or IOERR on the EXIT statement referenced by the I/O statement.

Example 1:

```
10 PRINT 1000*1.E+126 IOERR 20
20 END
```

Results in program interrupt 0003 on line 10 (9.99999999999999E+126 is displayed)

EXIT statement (continued)

Example 2:

```
10 PRINT USING 20: .001*1.E-126 IOERR 30
20 FORM PIC(##.  )
25 STOP
30 PRINT ERR
40 END
```

Results in a transfer to line 30.

- Data error
  - Overflow and underflow errors that are detected in data being read/input can be trapped by IOERR on the I/O statement (or IOERR on the EXIT statement referenced by the I/O statement). If the exponent of the data item is greater than three digits, this error is trapped by CONV.

Example 1:

```
10 INPUT A IOERR 20         ! where 1.E+130 is
15 STOP                     ! the value entered
20 PRINT ERR
30 STOP
```

Results in a transfer to line 20.

Example 2:

```
10 INPUT A CONV 20        ! where 1.E-9999 is
15 STOP                   ! the value entered
20 PRINT ERR
30 STOP
```

Results in a transfer to line 20.

EXP(X)

Returns the value of e (2.71828182845905) raised to the X power. For example:

```
10 X=1
20 Y=EXP(X)
```

Statement 20 sets Y to 2.718281828459.

X > = 292 will cause overflow.
X < = -292 will yield an answer of zero.

Exponential

see "EXP(X)"

Expressions

An expression in BASIC is a specification of a value using operators, constants, variables, arrays, array element references, and function references.

An arithmetic operator specifies an arithmetic operation to be performed on the data items.

Relational expressions are used with the IF statement to test the truth of specified relationships between two values. For example:

```
30 IF A>B THEN GOTO 100
```

Expressions referring to entire arrays, rather than individual array elements, are called array expressions. An expression that does not contain a reference to an entire array is called a scalar expression.

For more information on expressions, see:

- ''Arithmetic expressions and operations''
- ''Character expressions''
- ''MAT assignment statements''
- ''Relational expression'' under ''IF, THEN, ELSE statement''

Expressions, arithmetic

see ''Arithmetic expressions and operations''

Expressions, array

see ''MAT assignment statements''

Expressions, character

see ''Character expressions''

Expressions, relational

see ''Relational expression'' under ''IF, THEN, ELSE statement''

FIELDS

see ''Full screen processing''

FILENUM

FILENUM returns the numeric value of the file reference with the most recently detected error. -1 is returned if no errors have been detected.

Note: FILENUM must be assigned to a variable before printing or other I/O statement

Example

```
 5 OPEN #2: "NAME=J",INTERNAL,INPUT
10 READ #2: A$  EOF  30
20 GOTO 10
30 A=FILENUM
40 PRINT "FILE"; A; "HAD AN ERROR"
50 CLOSE #A:
60 STOP
```

File reference parameter

The file reference parameter associates a logical file with a physical file or device at OPEN time. It is defined in the OPEN statement for the file and is then referenced by subsequent I/O statements using the file or device.

File reference is an integer or numeric expression from 0 to 127 and 255 must be preceded by a # (pound sign). System assigned file references not requiring an OPEN statement are:

0	– Display, keyboard.
255	– System printer.

I/O statements such as INPUT, LINPUT, and PRINT, when used to direct data to and from the keyboard/display, do not require a file reference parameter.

```
10 PRINT "HELLO"! Display message
20 PRINT #255: "TOTALS"! Print message
30 FILEID$="NAME=FIL"
40 OPEN #7:FILEID$,INTERNAL,INPUT! Open file
50 READ #7:A$ ! Read a record
60 CLOSE #7:! Close the file
```

File searches

see "Diskette file searches"

File sharing

File sharing is used to OPEN a diskette file two or more times simultaneously.

Within a single 5322 Computer, file sharing permits a program to use a file by two or more access methods, simultaneously. For example, you may wish to simultaneously access a file for sequential and direct input.

Within a System/23 consisting of two 5322 Computers and a 5246 Diskette unit, file sharing permits two independently running programs in each 5322 Computer to share the same file in the 5246 Diskette unit.

The two 5322 Computers can at any time independently access two different files with no restrictions, the use of the 5246 Diskette unit cannot be simultaneous. None of the subsequent discussion applies to this case (see ''Device sharing'').

File sharing is regulated by a set of OPEN parameters which specify what level of sharing is permitted by the other OPEN which has already, or will in the future attempt to use the file. When a conflicting use is detected, the second and subsequent invalid OPENs fail with a 4148 error.

The information required to perform this function is stored with the file. If an OPEN specifies restricted use of the file and no corresponding CLOSE is executed to terminate this restriction (power loss or diskette removal), then the PROTECT command must be used to cancel these restrictions. See ''PROTECT command''. Use of the PROTECT command to CLOSE or RELEASE open files presently in use by a program should be avoided, as this can cause unpredictable results.

The default (no sharing specification), is no sharing permitted.

Sharing of Basic or H exchange files is permitted, no logical restrictions are imposed and any sharing other than input on both OPENs may produce unpredictable results. Any share specification is ignored for BX and HX files.

System/23 permits file sharing, it is the responsibility of the programmer to see that the proper level of sharing restrictions are imposed to maintain data integrity. Furthermore, it is the joint responsibility of the application programmer and the operator to see that the System/23 is operated in a manner consistent with data integrity. This includes:

- Proper power sequencing
- Removal and insertion of diskettes at the correct time
- Proper use of system commands
- Proper execution of programs and procedures

File sharing is controlled by four parameters in the OPEN statement; they are SHR, SHRI, NOSHR, and RESERVE. SHR means the other OPENs may use the file in any way, with the exception that only one OPEN may be for OUTPUT or OUTIN. SHRI means the other OPENs may do INPUT only. NOSHR (default) means no other OPENs are permitted.

File sharing (continued)

In summary:

First OPEN	Allowed subsequent OPENs
SHR,INPUT	SHRI or SHR, INPUT, OUTPUT or OUTIN
SHR,OUTPUT or OUTIN	SHR,INPUT
SHRI,INPUT	SHRI or SHR, INPUT
SHRI,OUTPUT or OUTIN	SHR,INPUT
NOSHR	none

RESERVE specifies that whatever sharing restriction is specified on this OPEN applies to the *other 5322 Computer* even after the file is CLOSED. This allows long term restriction of the file use, particularly when several programs, commands or Customer Support Functions must be run in succession without interference. The RESERVE restriction does not apply to the 5322 Computer which issued it. Thus, even if a file is OPENed NOSHR,RESERVE, after the corresponding CLOSE is executed, any subsequent OPEN may be used by the same 5322 Computer.

The RESERVE status is cleared by the RELEASE keyword on the CLOSE statement. The last program in a multi-step process would normally do a CLOSE...RELEASE to permit access to the file by the other 5322 Computer (this may be its only function). See "CLOSE statement".

The level of OPEN and RESERVE share restriction is indicated by the DIR DISPLAY. See "DIR command".

Programming considerations

- OPENs using key-indexed access (KEYED), place the same share restrictions on both the master and key files. (NAME= and KFNAME=).
- Share restrictions are ignored for BX and HX files.
- The RENAME, DROP, and FREE commands are rejected for a file which is OPEN or has any RESERVE status set by the other 5322 Computer.
- The RENAME, DROP, and FREE commands keep the 5246 Diskette unit for the entire command.
- The LINK, LOAD, MERGE, SORT, PROC, and SUBPROC commands open files INPUT, SHRI.
- The SAVE and REPLACE commands open files OUTPUT,NOSHR.
- The following Customer Support Functions ignore SHARE and RESERVE status, but secure the 5246 Diskette unit during their entire operation: Prepare Diskette, Copy Diskette (image copy only), Recover Diskette, and Display Diskette Label. File Recovery will copy the SHARE and RESERVE status.
- Machine Update Generator, Collation Sequence Alternator, REPLACE, Presort, SORT and Index Generator open output files NOSHR.
- Presort, SORT, and Index Generator use WSID$ as a suffix for work file names.

File sharing (continued)

- If both 5322 Computers do a LOAD, edit, and REPLACE of the same file, the last REPLACE will overlay any preceding REPLACE. To prevent this compromise of SOURCE files, OPEN the file NOSHR,RESERVE and then CLOSE it. After editing and REPLACE, then PROTECT...RELEASE.

- The VOLID command can be used to change the diskette VOLID at any time. If this is done while a file is open on the diskette, it may prevent further processing of the file.

- If the copy all files option of the Copy Customer Support Function is used, the following errors are possible:
  - Use of the FREE, DROP, or RENAME commands during Copy can lose a file to be copied.
  - A file added to the copy from diskette while Copy is running may not be copied.

- Incorrect use of the PROTECT CLOSE or RELEASE options can compromise data integrity by removing share restrictions when they are still needed.

File size

see ''Diskette file size''

File specification parameter

The file specification parameter consists of a file name, followed by a volume identification (VOLID) and device address. File names may be of the following types:

- Simple file names may be from one to eight characters in length. The first character must be alphabetic (A–Z). The remaining characters may be alphabetic (A–Z) or numeric (0–9). Blanks are not permitted. Simple file names are required for Basic and H exchange files.

- The names of the System/23 format (Z) files consist of one or more simple names separated by periods. The total number of characters, including periods, is 17.

```
CUSTOMER.EMPLOYEE
X.Y.Z
```

VOLID identifies the diskette on which the file is to be created or found. VOLID is up to six characters long and may consist of alphabetic or numeric characters.

Device address identifies the I/O device being used (see ''Device address parameter'').

File specification can be in one of the following forms:

- filename
- filename/VOLID
- filename/VOLID/device
- filename//device
- //device

See ''RENAME command'' and ''VOLID command''.

File specification parameter (continued)

Examples

```
CUSTOMER.EMPLOYEE//2
X.Y.Z/TEMP
//10
```

Note: The file specification //10 is used in an OPEN statement to open the system printer.

Files, related subjects

CHAIN statement	LINPUT statement
CLEAR statement	ON statement
CLOSE statement	OPEN statement
CMDKEY	OPTION statement
CNT	PIC$(C$)
CODE	PRINT statement
Customer Support Functions	PROC command
DELETE statement	Procedure files
DIR	Device sharing
DISPLAY	
DROP/FREE command	PROTECT statement
END statement	READ statement
ERR	REC(N)
EXIT statement	Relative record files
FILENUM	RENAME command
FILE(N)	REPLACE command
File reference parameter	REREAD statement
File sharing	RESTORE statement
File sizes	REWRITE statement
File specification parameter	RLN(N)
FILE$(N)	SAVE command
FORM statement	SORT command
FREESP(N)	STOP statement
INPUT statement	SUBPROC command
Internal I/O file formatting	
I/O Tables (Appendix B)	
Key-indexed files	USE command
KLN(N)	VOLID command
KPS(N)	WRITE statement
LINE	WSID$

FILE(N)

FILE returns a numeric value to indicate the status of file N. One of the following values is returned:

Value	Description
-1	File not opened
0	Operation occurred successfully
10	End of file occurred during input
11	End of file occurred during output
20	Transmission error occurred during input
21	Transmission error occurred during output

FILE$(N)

FILE$ returns a string containing the file specification (file name, volume identification, and device address) of file N. If file N is not open, the null string is returned.

Fixed-point format

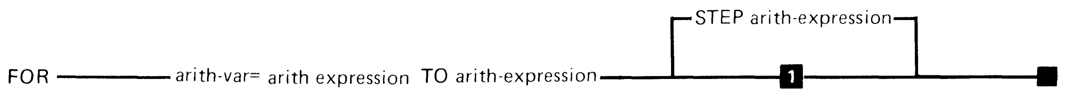
see "Arithmetic data"

Floating currency symbol

see
"PIC specification" under "FORM statement"
"PIC$(C$)"

Together, a FOR statement and its paired NEXT statement delimit a FOR loop. A FOR loop is a set of BASIC statements that can be executed one or more times. The FOR statement marks the beginning of the loop and specifies the conditions of its execution and end. The NEXT statement marks the end of the loop.

FOR syntax



1 STEP=1

The syntax of the FOR statement is as shown above, where:

arith-var is an arithmetic variable (not an array name) used as the loop control variable and identify the associated NEXT.

arith-expression is an expression that specifies an initial value for the control variable, the final value of the control value (where execution of the loop will end), and the amount that the control variable will increment after each execution of the loop. If STEP and the increment-num are omitted, an increment of 1 is assumed.

Upon initial entry in the FOR loop, all expressions are evaluated. The initial value of the control variable is tested against the final value of the control variable. If the initial

FOR and NEXT statements (continued)

value is greater than the final value for positive STEP values, or less than the final value for negative STEP values, the loop is not executed. In this case, the value of the control variable is set to the initial value and control goes to the statement following the NEXT statement. Otherwise control is passed to the statement following the FOR.

NEXT syntax

```
NEXT———arith-var———■
```

The syntax for the NEXT statement is as shown above, where:

arith-var is an arithmetic variable used as the loop control variable. If the loop is executed, the control variable is set equal to the initial value, and the statements in the loop are executed. When the NEXT statement is executed, control is transferred to the associated FOR statement and the STEP value is added to the control variable, which is then compared with the final value. If the control variable for positive increments is less than or equal to the final value, the loop is executed again and the cycle continues until an increment is made that makes the control variable greater than the final value. At that time, control transfers to the first executable statement following the associated NEXT statement. If the increment is negative, the loop executes while the control variable is greater than, or equal to the final value.

Examples

The following example shows a simple FOR loop that increases the control variable A by 2 until the value of 25 is exceeded.

```
20 FOR A=1 TO 25 STEP 2
 •
 •
 •
90 NEXT A
```

The following example shows the technique for nesting FOR loops. The internal loop is executed 100 times for each execution of the outer loop.

```
10 FOR J=A TO B STEP C
 •
 •
 •
150 FOR K=1 TO 100
 •
 •
 •
250 NEXT K
 •
 •
 •
300 NEXT J
```

FOR and NEXT statements (continued)

Programming considerations

- Parameters fixed at loop entry
  - The value of the control variable can be modified by statements within the FOR loop, but its initial value, its final value, and the STEP value are established during the initial execution of the FOR statement and are not affected by any statement within the FOR loop.

- Zero STEP
  - If the value of the STEP increment-num is zero, the FOR loop is executed until the value of the control variable is purposely set beyond the specified final value by a statement in the loop.

- Errors
  - Transfer of control into or out of a FOR loop is permitted; execution of a NEXT statement without execution of a corresponding FOR statement causes an error.
  - FOR loops can be nested within one another as long as the internal FOR loop falls entirely within the external FOR loop. Nested FOR loops should not use the same control variable, because the inner loop will modify the value of the outer loop control variable.

  - The maximum number of nested FOR-NEXT loops is a variable number (normally around 50). If the maximum is exceeded, a system error will occur.
  - Modification of a FOR or NEXT statement during execution is not permitted.

- Exit control value
  - The value of the control variable at exit from FOR/NEXT loop is the first unused value.

Example

```
10 FOR I=1 to 10
20 PRINT "TEST"
30 NEXT I

The value of I is 11
```

FORM statement

The FORM statement is used to describe the way output should look when the PRINT, WRITE, or REWRITE statement is used. The FORM statement also describes the way input looks when using a READ or REREAD statement.

The FORM statement is used to control the number of output positions taken by a value being displayed. The following program writes ƀƀƀ99 in columns 1 through 5 on line 22 on the screen:

```
10 PRINT USING 20: 99
20 FORM N 5
```

where N 5 is a data conversion specification. N specifies the format type *numeric*. 5 specifies the *field length*.

The FORM statement is also used to control the number of digits displayed in a decimal fraction. For example, the following program writes 12.35 in columns 1 through 5 on line 22 on the screen:

```
10 PRINT USING 20: 12.345
20 FORM N 5.2
```

where N 5.2 is a data conversion specification. N specifies numeric. The field length is 5, and the fraction is rounded to 2 *decimal digits*.

To display character data, use the C data conversion specification. The following program writes "Number of parts in stock:" in positions 1 through 25 on line 22:

```
10 PRINT USING 20: "Number of parts in stock:"
20 FORM C 25
```

where C identifies the format type and 25 is the field length.

The following program shows two I/O list items being output:

```
10 PRINT USING 20: "Number of parts in stock:",99
20 FORM C 25,N 5
```

where C 25 is the data conversion specification for the first I/O list item and N 5 corresponds to the second. The output in columns 1 through 30 on line 22 is "Number of parts in stock:ƀƀƀ99".

To increase the spacing between I/O list items, use the X data conversion specification. The following program outputs "Number of parts in stock:ƀƀƀƀƀƀƀƀ99" in positions 1 through 35 on line 22:

```
10 PRINT USING 20: "Number of parts in stock:",99
20 FORM C 25,X 5,N 5
```

where X is the format type and 5 is the field length. X 5 causes five blanks to be inserted in the output. No I/O list item is associated with X 5.

The above examples show the FORM statement being used with the PRINT statement. The FORM statement can also be referenced by the READ, WRITE, REREAD, and REWRITE statements. When FORM is used with these statements, output is to a record in an internal I/O file, and input is from a record in an internal I/O file.

FORM statement (continued)

The following example shows three values being written into a record of an internal I/O file:

```
10 WRITE #n,USING 20: "XYZ",30,10
20 FORM C 3,N 4,N 4
```

The previous example assumes the record length of the records in the file is greater than or equal to 11. If the record length were less than 11, an error would occur, because the field length for the third I/O list item would span the end of the record. If this file were open for input, the second and third values in the same record could be read as follows: (The first value is skipped.)

```
10 READ #n,USING 20: A,B
20 FORM X 3,N 4,N 4
```

The following example shows an alternative way of reading the same values from the same record:

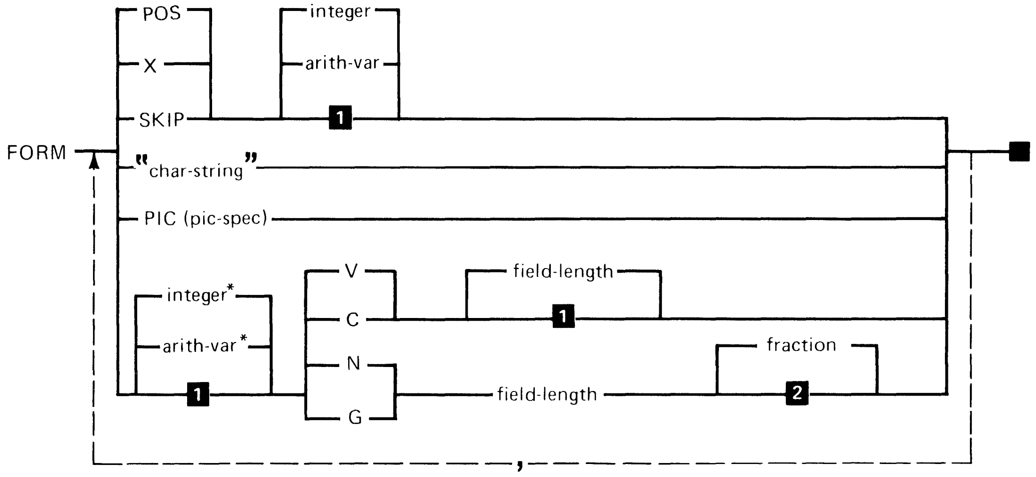
```
10 READ #n,USING 20: A,B
20 FORM X 3,2*N 4
```

where 2* is a replication factor. It says to use the N 4 data conversion specification twice.

The FORM statement can be referenced by a line number or label in a USING clause of an I/O statement. The FORM statement can also be contained in a character variable. In the latter case the character variable is referenced in a USING clause in the I/O statement. Examples showing the FORM statement referenced by a label and the FORM statement contained in a character variable are included in the following program:

```
10 !  Label Reference
20 PRINT USING LAB1: 99
30 LAB1: FORM N 5
40 ! FORM Statement Defined in Character Variable
50 A$='FORM N 5'
60 PRINT USING A$: 99
```

Many additional data conversion specifications are supported by the FORM statement. The syntax of the FORM statement (when referenced by a PRINT statement) and which data conversion specifications are supported, is shown below:

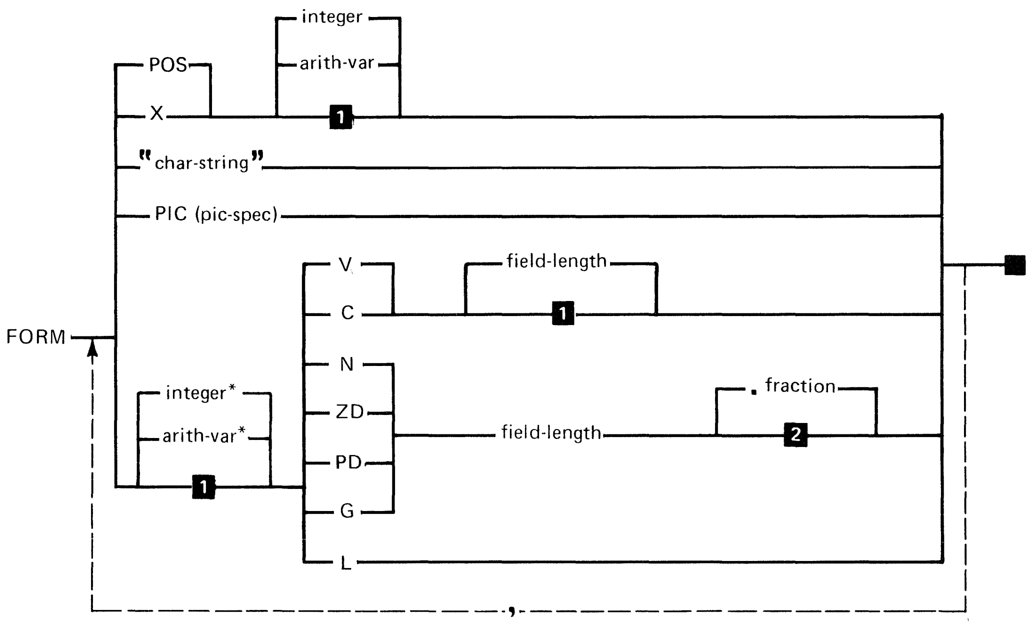


■1 1
■2 Fraction length=0

Note that a blank is required between a format identifier (e.g. POS or V) and any integer or variable which follows.

FORM statement (continued)

The syntax of the FORM statement (when referenced by a READ, WRITE, REREAD, or REWRITE statement) and which data conversion specifications are supported is shown below.



1 1
2 Fraction length=0

Note that a blank is required between a format identifier (e.g. POS or V) and any integer or variable which follows. The "char-string" and PIC specifications are not supported on the READ and REREAD statements.

Detailed descriptions of the FORM data conversion specifications follow.

POS (for a PRINT statement) specifies the position in the line for the next value to be printed. If POS is less than the current position, the current line is printed and a new line started. The next I/O list item will be printed in the new line at the position specified.

If one or more items have been printed on the current line and if the value of POS is beyond the end of the current line, positioning is as follows: Let N equal POS minus the current line position. The current line is then printed. N blanks are then written starting at the beginning of the next line.

The value specified for POS can range from 1 to 4095. The default is 1. Non-integer values in arithmetic variables are rounded.

POS (for a READ, REREAD, WRITE, or REWRITE statement) specifies the position in the record to be accessed. Positioning can be forwards or backwards in the record. The value specified for POS can range from 1 to the smaller of 4095 or the record length. The default is 1. Non-integer values in arithmetic variables are rounded.

Note: Output records are initialized to blanks by the WRITE statement and to the current record content by the REWRITE statement.

X (for a PRINT statement) specifies the number of blanks to be printed. If the value specified for X is greater than the number of positions remaining on the current line, the current line is printed, and the number of blanks specified for X is then written starting at the beginning of the next line.

FORM statement (continued)

The value specified for X can range from 1 to 4095. The default is 1. Non-integer values in arithmetic variables are rounded.

X (for a READ, REREAD, WRITE, or REWRITE statement) specifies the number of positions to be skipped. The value specified for X can range from 1 to the smaller of 4095 or the number of positions remaining in the current record. The default is 1. Non-integer values in arithmetic variables are rounded.

Note: Output records are initialized to blanks by the WRITE statement and to the current record content by the REWRITE statement.

SKIP (for a PRINT statement) specifies that the current line is to be printed and that n-1 (where n is the value specified for SKIP) blank lines should appear in the output. The next output will begin in the first position of the following line. If the value specified for SKIP is zero, there will be no line feed, and overprinting will occur. See example at the end of this FORM statement section.

The value specified for SKIP can range from 0 to 255. The default value is one. Non-integer values in arithmetic variables are rounded.

char-string (for a PRINT, WRITE, or REWRITE statement) specifies a character string to be output. The field width is the length of the character string within quotation marks.

integer * and *arith-var* * specifies the number of times the data format should be used. The same format can be used repeatedly. This parameter must range from 1 through 255. The default value is 1. Non-integer values in arithmetic variables are rounded.

C specifies character data. For a READ or REREAD statement, the number of characters specified by C are assigned from the input field to the character variable listed in the READ or REREAD statement. If the maximum variable length is less than the field-length specified, a string overflow (SOFLOW) occurs. If the variable length is greater than the field-length specified, the length of the character variable is set to field-length.

For input, an example is:

```
10 READ #n,USING 20:A$
20 FORM C 10
```

If the input field is

ABC ƀƀƀƀƀƀƀ

the trailing blanks are kept and the variable A$ is assigned a length of 10.

For output, the value of the corresponding character expression in the WRITE, REWRITE, or PRINT statement is left-justified in the output field and padded with blanks. If the length of the expression is longer than field-length, a string overflow (SOFLOW) will occur.

The C parameter is valid for character expressions and will cause a conversion (CONV) error if used with a numeric expression. The value specified for field-length can range from 1 to 255. The default is 1.

FORM statement (continued)

N specifies numeric data. For input, the number of record positions specified by the field-length must contain a numeric value in character form. The numeric value can have any one of the formats described in ''Arithmetic data'' (integer, fixed, or floating point). Leading and trailing blanks are ignored. If the numeric value is an integer, the number of digits specified by fraction length are used to generate the decimal fraction. The remaining high order digits in the field are used to generate the interger portion of the result. If the input numeric value is fixed or floating point, fraction length is ignored. For input, the numeric value is truncated to 15 significant digits. If option INVP is in effect, a comma in the input field will be treated as a decimal point. If the input field is left blank, a zero will be the default.

For output, the corresponding numeric value in the output list is converted to character representation and is right-justified in the output field. If fraction length is not specified, the output field will contain the rounded integer value of the numeric expression. If fraction length is specified, the decimal fraction is rounded to the length specified. The result, including the decimal point, will be placed in the output field. (If option INVP is in effect, a comma will be output in place of the decimal point.) If the numeric expression is negative, a minus sign will precede the numeric value in the output field. Plus signs are not inserted into the output field. The field-length must be large enough to contain any minus sign, integer digits, decimal point, and decimal digits.

The N parameter is valid for a numeric expression and will cause a conversion error if used with a character expression. The value specified for field-length can range from 1 to 26.

The following are examples of N format specifications:

Value to be written (decimal)	Specification	Resulting output (characters)
3.45	N 7.2	3.45
3.45	N 7.1	3.5
-3.45	N 7	-3
-3.45	N 7.1	-3.5

ZD specifies the zoned decimal format for numeric values. A zoned decimal field contains the character representation of the numbers 0-9 (hex F0-F9). Each byte of a zoned decimal field contains a high order 4-bit zone (hex F) and a low order 4-bit digit (0-9). The zone of the rightmost digit is used to represent the sign of the field. F or C is plus, and D is minus. No other values are allowed.

For input, the specification ZD field-length specifies that the next field-length bytes in the record contain a numeric value in zoned decimal form (one digit per byte). The optional specification, fraction length, identifies the number of rightmost digits to be used for decimal positions in the number. The default value is 0. See examples of ZD format specifications.

For output, an internal numeric value is converted to zoned decimal. If fraction length is not specified, the rounded integer value is used to generate the field. If fraction length is specified, the decimal fraction is rounded to the length specified. The field length must be large enough to contain all integer and decimal digits. The decimal point is not included.

FORM statement (continued)

The ZD parameter is valid for numeric expressions and will cause a conversion (CONV) error if used with a character expression. The value specified for field-length can range from 1 to 32.

The following are examples of ZD format specifications:

Value to be written (decimal)	**Specification**	**Resulting output (hexadecimal)**
3.45	ZD 7.2	F0 F0 F0 F0 F3 F4 F5
3.45	ZD 7.1	F0 F0 F0 F0 F0 F3 F5
-3.45	ZD 7	F0 F0 F0 F0 F0 F0 D3
-3.45	ZD 7.1	F0 F0 F0 F0 F0 F3 D5

PD specifies the packed decimal format for numeric values. Field-length specifies the length of the field in bytes, and fraction length specifies the number of digits to the right of the decimal point. Each digit of a PD field occupies one half of a byte (4 bits), 2 digits per byte. The rightmost four bits are hexadecimal F or C for plus and hexadecimal D for minus.

For input, field-length specifies the number of bytes in a record containing a numeric value in packed decimal format (two digits per byte, with one digit and a sign in the rightmost byte). This value will be assigned to a numeric variable in a READ or REREAD statement. If the fraction length parameter is not specified, the field is assumed to contain an integer.

For output, field length specifies the number of record bytes into which the corresponding numeric expression from the WRITE or REWRITE statement will be placed. The expression is converted to packed decimal format. If fraction length is not specified, the rounded integer value is used to generate the field. If fraction length is specified, the decimal fraction is rounded to the length specified. The field length must be large enough to contain all integer and decimal digits plus the sign.

The PD parameter is valid for numeric expressions and will cause a conversion (CONV) error if used with a character expression. The value specified for field-length can range from 1 to 32.

The following are examples of PD format specifications:

Value to be written (decimal)	**Specification**	**Resulting output (hexadecimal)**
3.45	PD 7.2	00 00 00 00 00 34 5F
3.45	PD 7.1	00 00 00 00 00 03 5F
-3.45	PD 7	00 00 00 00 00 00 3D
-3.45	PD 7.1	00 00 00 00 00 03 5D

L specifies internal floating-point format (9 bytes) for numeric values.

For input, L specifies that an internal floating-point format value in the record is to be assigned to a corresponding numeric variable specified in the READ or REREAD statement. The contents of the field is not checked for validity.

FORM statement (continued)

For output, L specifies that the value of a numeric expression in the WRITE or REWRITE statement will be written in the record in internal floating-point format.

The following are examples of L format specifications:

Value to be written (decimal)	Specification	Resulting outputs (hexadecimal)
3.45	L	01 03 45 00 00 00 00 00
-3.45	L	01 83 45 00 00 00 00 00

V specifies variable length character data.

For input, field-length specifies the length of the field to be read. The string, excluding trailing blanks, is assigned to the character variable. The variable assumes that length. If the field-length is larger than the variable's maximum length, a string overflow (SOFLOW) will occur. An example of V-format is as follows:

```
10 READ #n, USING 20: A$
20 FORM V 10
```

If the input field is ABCDƀƀƀƀƀƀ, the trailing blanks are dropped and the data ABCD, with a length of 4, is assigned to the variable.

For output, the value of the corresponding character expression in the PRINT, WRITE, or REWRITE statement is left-justified in the output field defined by V and padded with blanks. If the length of the expression is larger than the field-width specified, a string overflow (SOFLOW) will occur.

The V parameter is valid for character expressions and will cause a conversion (CONV) error if used with a numeric expression. The value specified for field-length can range from 1 to 255. The default is 1.

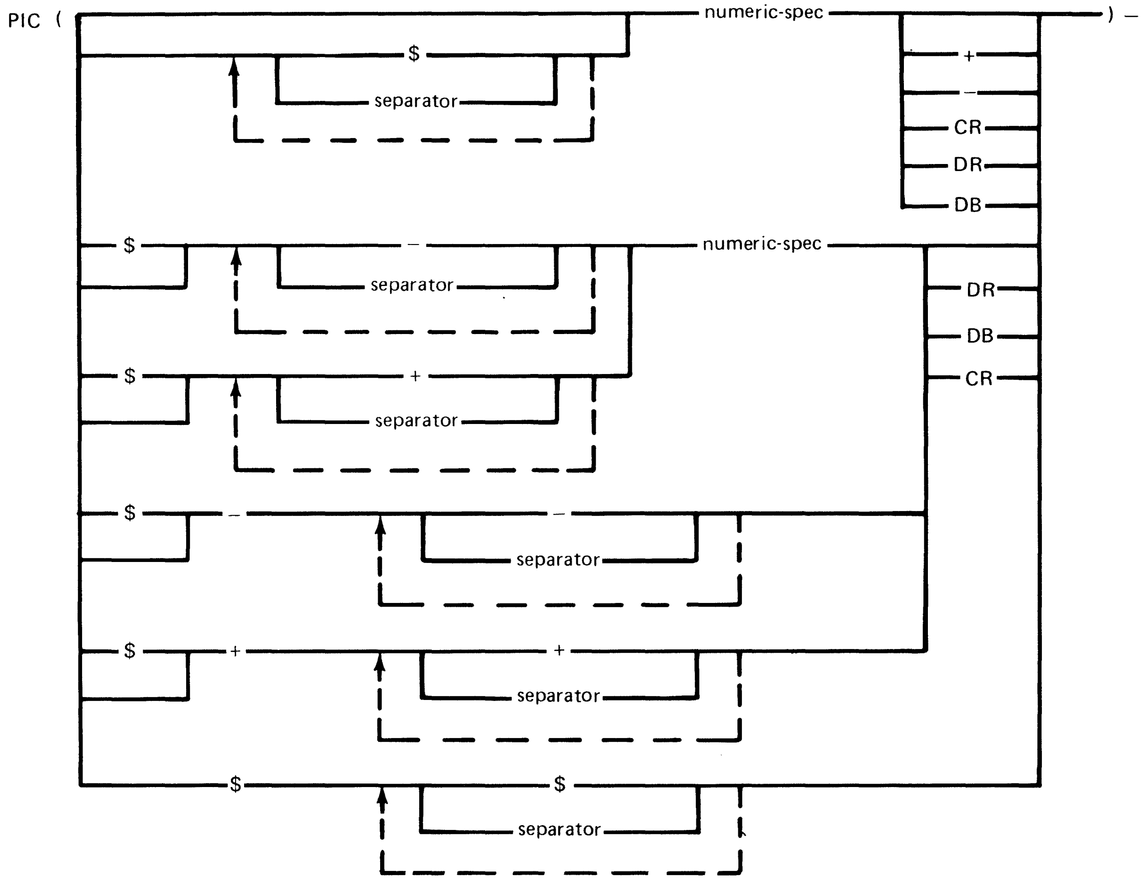
G allows both character and numeric data to be used. If the I/O list item is numeric, the rules are the same as for N.

If the I/O list item is character, the rules are the same as for V. If the I/O list item is character, field length and fraction length are optional. If fraction length is specified, it is ignored.

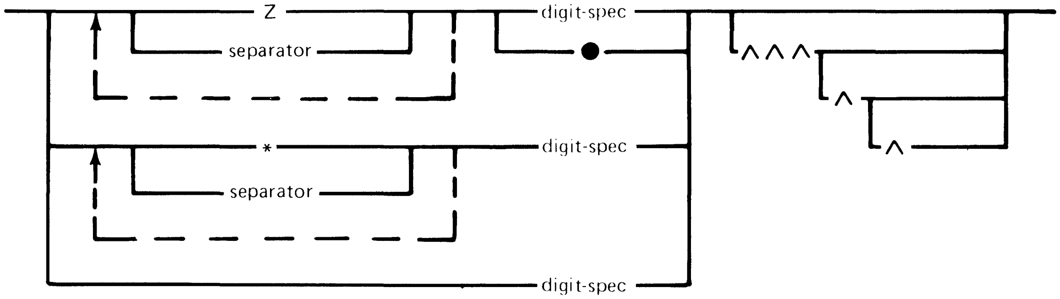
FORM statement (continued)

PIC specification

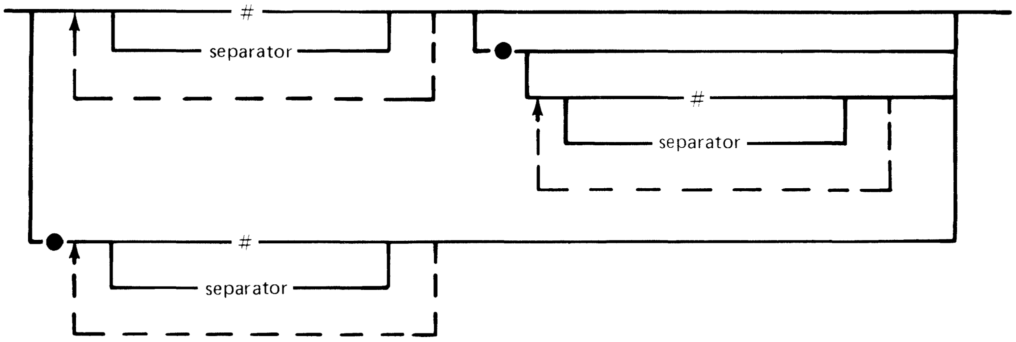
PIC is a data conversion specification having the following syntax:



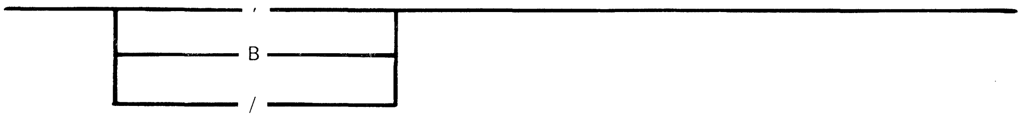
The syntax for *numeric-spec* is as shown:



The syntax for *digit-spec* is as shown:



The syntax for *separator* is as shown:



FORM statement (continued)

Each symbol represents one character position in the output. The output field-width, (the number of symbols specified) can range from 1 to 32.

The I/O list item being output can be character or numeric. The following examples show the use of PIC to output character data:

Character string to be output	**PIC specification**	**Printed output**
August	PIC(######)	August
May	PIC(######)	Mayƀƀƀ
July	PIC(ZZZZZ)	Julyƀ
June	PIC($$.##)	Juneƀ

Each # symbol represents one character to appear in the output. When the character string length is less than the field-width, the character string is left-justified in the field and padded with blanks. When the character string length is greater than the field-width, a string overflow (SOFLOW) will occur. When character data is being output, the # symbol and all other PIC symbols defined in the following paragraphs are character specifiers.

If the I/O list item is numeric, the PIC specification contains combinations of symbols which represent what the output should look like. The symbols are divided into the following four categories:

- Digit specifiers
- Insertion characters
- Exponent specifiers
- Trailing characters

Digit specifiers

The following digit specifiers can be specified:

Specifier	Meaning
#	A numeric digit is printed.
Z	A numeric digit is printed. A blank replaces a leading zero (or conditional insertion character). Z may not appear to the right of a decimal point. Z is treated the same as a # if an exponent specifier is used.
*	A numeric digit is printed. An asterisk replaces a leading zero (or conditional insertion character). * may not appear to the right of a decimal point. * is treated the same as a # if an exponent specifier is used. For zero value the decimal point is replaced by an * if the decimal is the last character of the specification. * will not float across the decimal point to replace an insertion character.
$	A currency symbol is printed. If more than one $ symbol appears in the PIC specification, the currency symbol will appear in the position of the rightmost $ symbol which overlaps a leading zero (or conditional insertion character). The character to be printed as the currency symbol may be set by the PIC$ function.

FORM statement (continued)

The default is $. + or – may not precede the $. $ will not float across the decimal point to replace an insertion chracter. $ may not follow a decimal point. A specification of all $, outputs zero as a single $.

+	A plus sign is printed for a positive number, and a minus sign is printed for a negative number. If more than one + symbol appears in the PIC specification, the plus or minus sign will appear in the position of the rightmost + symbol which overlaps a leading zero. + may not precede a $. A floating + may follow a single $.
–	A minus sign is printed for a negative number, and a blank is printed for a positive number. If more than one – symbol appears in the PIC specification, the minus sign or blank will appear in the position of the rightmost – symbol which overlaps a leading zero. A – sign may not precede a $. A floating – may follow a single $.

The following are digit specifier considerations.:

- A floating +, –, or $ will float to the right across a B, comma, or a /. If the first significant digit is immediately to the right of a / or comma, the +, –, or $ will replace the / or comma. A blank (B) is not replaced and the +, –, or $ appears to the left of the B (blank).
- Although the System/23 permits Z or * to follow a floating $, +, or –, this should be avoided since other systems may not support this function. For example:

```
PIC($$$**.##)
```

should be replaced by:

```
PIC($$$$$.##)
```

FORM statement (continued)

The following are examples of digit specifiers. Assume the data value 123456 is to be printed.

```
PIC specification      Printed output

PIC(#########)         000123456
PIC(ZZZZZZZZZ)            123456
PIC(ZZZZZZ###)            123456
PIC(******###)         ***123456
PIC($$$$$$###)           $123456
PIC(++++++###)           +123456
PIC(----#####)            123456
```

If a currency symbol, plus sign, or minus sign is specified once in the PIC specification, it is printed in the position indicated.

```
PIC specification      Printed output

PIC($ZZZZZ###)          $ƀƀ123456
PIC(+ZZZZZ###)          +ƀƀ123456
PIC(---######)             123456
PIC($+++#####)          $ƀ+123456

Using the value .05:
PIC($$$./##)            ƀƀ$.05
PIC($$$B.##)            ƀƀ$ƀ.05

Using the value 0
PIC(###)                ƀƀ$
```

Insertion characters

Insertion characters insert additional characters into a field, generally to improve readability. The following insertion characters can be specified:

Character	Meaning
B	A blank is printed.
	A comma is printed. If no digit precedes the comma, the comma is replaced by the zero suppression character (blank or asterisk) or currency symbol. If OPTION INVP is in effect, a decimal point will replace the comma in the output.
/	A slash is printed. If no digit precedes the slash, the slash is replaced by the zero suppression character (blank or asterisk) or currency symbol.
	A decimal point is printed. Only one decimal point may be specified. If option INVP is in effect, a comma will replace the decimal point in the output.

A PIC specification cannot begin or end with a B (blank), comma, or /.

FORM statement (continued)

The following are examples of insertion characters. Assume a data value of 112233 is to be printed:

```
PIC specification          Printed output

PIC(###B##B#####)          000ƀ11ƀ2233
PIC(ZZZBZZBZ###)              11ƀ2233
PIC(ZZZ,ZZZ,###)              112,233
PIC(ZZZZZ/Z#/##)             11/22/33
PIC(******#.##)             *112233.00
PIC($$$,$$$,$$$.##)        $112,233.00
```

Exponent specifier

The exponent specifier appears in the rightmost positions of a PIC specification, preceding the trailing characters, if any, as three, four, or five circumflex characters. The corresponding output positions are the letter E, the exponent sign (+ or -), and the exponent value. If the PIC specification also includes zero suppression symbols (Z, $, +, -, or *), the # symbol is substituted for them. A decimal point will always appear in the output in the same position as it appears in the PIC specification.

Values are rounded to the number of digit specifiers before output. For a floating field of +, -, or $, the first specifier is not included in this number. All digits will be used. The leading digit will be non-zero. An error occurs only if the exponent cannot be accommodated.

The following are examples of exponent specifiers. Assume a data value of 6.2345E+23 is to be printed:

```
PIC specification        Printed output

PIC(#######^^^^)           6234500E+17
PIC(##.###^^^^^)           62.345E+022
PIC(##.##^^^^)             62.35E+022
PIC(.######^^^^)           .623450E+24
PIC(ZZZ.ZZ^^^^)          623.45E+21
PIC(##.^^^^^)             62.E+022
```

FORM statement (continued)

Trailing characters

The following trailing characters can be specified:

Character	Meaning
+	A plus sign is printed for a positive number, and a minus sign is printed for a negative number.
-	A blank is printed for a positive number, and a minus sign is printed for a negative number.
CR, DB, or DR	The characters CR, DB, or DR, respectively, are printed for a negative number. For a positive number, either two blanks or two asterisks are output. Asterisks are output if * symbols were specified to suppress leading zeroes. Leading signs and CR, DB, or DR can appear simultaneously.

The following are examples of trailing characters. Assume a data value of -123456 and 123456 are printed in alternating sequence.

```
PIC specification      Printed output

PIC(##########+)         0000123456-
PIC(##########+)         0000123456+

PIC(##########-)         0000123456-
PIC(##########-)         0000123456ƀ

PIC(ZZZZZZZZZCR)            123456CR
PIC(ZZZZZZZZZCR)            123456ƀƀ

PIC(*********DR)         ***123456DR
PIC(*********DR)         ***123456**

PIC($$$$$$###DB)           $123456DB
PIC($$$$$$###DB)           $123456ƀƀ

PIC($++++####DB)           $ƀ-123456ƀƀ
PIC($++++####DB)           $ƀ+123456DB
```

FORM statement (continued)

Programming considerations

- FORM statement
  - If the number of I/O list items exceeds the number of FORM data conversion specifications, the FORM statement is reused. (For a PRINT statement, there is a default SKIP 1 at the end of the FORM statement.)
  - Array elements are formatted in row order.
  - For a PRINT statement, if the field width specified in a data conversion specification is greater than the number of positions remaining on the current line, the current line is printed. The value to be output is then printed at the beginning of the next line.
  - FORM statements are non-executable and can be placed anywhere in a BASIC program; either before or after the I/O statements that reference them.

- PIC data conversion specification (numeric data)
  - The number of digit specifiers representing the integer portion of the value being output must equal or exceed the number of integer digits in the value itself. When one or more +, –, or $ symbols are used as digit specifiers, one additional digit specifier is required.
  - The PIC specification is not syntax checked until execution time.
  - The number of circumflex characters representing an exponent must equal or exceed the number of digits in the exponent itself plus two.

- If a negative value is being output, the PIC specification must contain either a leading + or – specifier or a trailing +, –, CR, DB, or DR symbol.
- A PIC specification must contain at least one Z, *, #, or have at least two $, +, or — specification characters.
- Values are rounded before output for fixed-point fields (no exponents). The value is rounded into the digit positions specified. For exponential output, the value is rounded to the number of digits specified. In both cases, one digit is deducted for floating $, +, or -.
- If a floating currency string is followed by a decimal point, it must also be followed by one or more #.
- The floating + or - will not be printed for a zero value if no fractional digits are specified.
- If a floating currency string is followed by a trailing sign or exponent specifier, the currency field must be followed immediately by at least one #, Z, or *.

FORM statement (continued)

Example

The following program is an example of the use of the FORM statement to format printed output:

```
10 A=11
20 B$="ABC"
30 C=5
40 D$="DEF"
50 E=16.2
70 PRINT USING 80: A,B$,C,D$,E,"GHI"
80 FORM POS 3,N 3,X 2,C 4,SKIP 1,"COMMENT",
   PIC(###),V 4,2*G 4.1
```

The following output will be displayed in lines 21 and 22, respectively.

```
ƀƀƀ11ƀƀABC
COMMENT005DEFƀ16.2GHI
```

Formatting I/O files

see "Internal I/O file formatting"

FNEND statement

see "DEF, FNEND statement"

FREE command

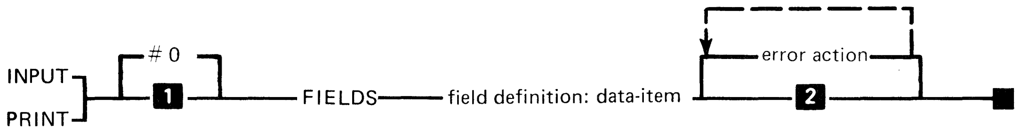
see "DROP/FREE command"
"CLOSE statement"

FREESP(N)

FREESP returns the number of 512-byte areas available for allocation on the diskette that contains file N. Space allocation is made in 512-byte increments. A -1 is returned if the file is not open, if it is an exchange file, or if the device is not a diskette.

Full screen processing

Full screen processing is used to display or input data using the entire screen (except the status line). To display data with full screen processing *PRINT FIELDS* must be entered. To input data with full screen processing *INPUT FIELDS* must be entered. If the keyword FIELDS is not included, standard PRINT and INPUT processing is used. The syntax of the PRINT/INPUT statement for full screen processing is as follows:



1 #0
2 Interrupt on error unless ON is active

where:

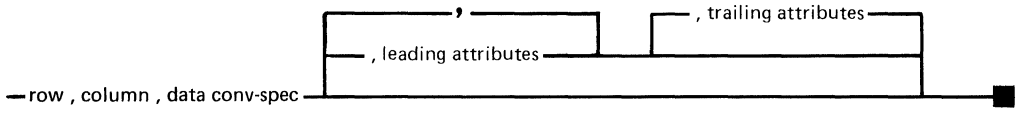
#0 is a numeric expression having the value of 0 for full screen processing (see "File reference parameter").

field definition is either a character expression or a MAT character array name (where character array name is a one-dimensional array).

data-item is a simple variable, subscripted array, or a MAT array name.

error-action is an EXIT line-ref or a CONV, SOFLOW, EOF, IOERR (see"EXIT statement").

A character expression specified for FIELDS defines one field. Multiple fields are defined in a character array. The array element or character expression defining a field is a character string having the following syntax:

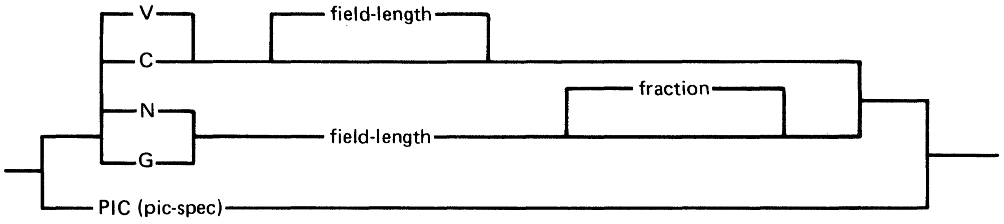


The parameters are positional and are delimited by commas. The insertion of blanks preceding or following individual parameters is permitted.

The starting location of a field is defined by the row and column parameters specified in the field definition. Row 1, column 1 is the upper left-hand corner of the screen. Fields may be defined on rows 1 through 23. The length of a field is the length specified either explicitly or implicitly in the data conversion specification. Fields may not span lines. The maximum length of a field is 78 (columns 2 through 79) for a field defined with leading and trailing display attributes. Leading and trailing display attributes are required for input fields. The maximum length of an output field without attributes is 80 (columns 1 through 80).

Full screen processing (continued)

The following data conversion specifications are supported in a field definition:



V, C, N, G, and **PIC** have the same syntax and function as described under the "FORM statement." PIC is not supported on an INPUT FIELDS statement.

Leading and trailing attributes

Two types of attributes may be associated with fields: display attributes and control attributes.

Display attributes

Display attributes affect the visual characteristics of the display screen. The attribute "blink," for example, specified as a leading attribute for a field, causes the field to blink. The attribute "normal" specified as a trailing attribute, returns the screen to normal. Display attributes occupy screen locations. These locations appear blank. They may not simultaneously contain data. A display attribute affects the visual characteristics of the screen starting at the location following the attribute up through the location preceding the next display attribute.

The following display attributes are supported:

- I—Invisible
- U—Underline
- B—Blink
- H—Highlight
- R—Reverse (black on green)
- N—Normal (visible, no underline, no blink, no highlight, green on black)

When specified in combination, attribute I overrides attributes U, B, H, R, and N. Attributes U, B, H, and R override attribute N.

Full screen processing (continued)

Example

Underline and blink:

```
10 PRINT FIELDS "10,10,C 40,UB,N":"HELLO"
```

Highlight:

```
20 PRINT FIELDS "10,10,C 20,H,N":"Hi"
```

Underline input fields:

```
30 INPUT FIELDS "10,10,C 20,U,N":A$
```

Control attributes

The second attribute type is the control attribute, which is used to modify input field operations. The following control attributes are effective when specified as leading attributes in an input field definition:

- C—Position the cursor to this input field first. If C is specified for more than one field, the cursor is positioned to the last field in the array having the C attribute.
- A—Automatic field exit. An automatic field exit occurs when the operator keys a character into the last location within this field.

- E—Automatic enter. An automatic enter occurs when the operator presses the Field Exit, Field Plus, or Field Minus key. An automatic enter also occurs when the operator enters a character into the last position of a field having the A attribute.

Control attributes do not occupy screen locations.

Any combination of display and/or control attributes may be specified for leading or trailing attributes in a field definition. Control attributes are inactive when specified for a PRINT field or as trailing attributes for an INPUT field. When an attribute is not recognized, it is ignored. If more than one display attribute is specified, the combination occupies one screen location. This location is R, C-1 for leading attributes and R, C+L for trailing attributes (R, C, and L are row, column, and length of the field). Input fields require both a leading and trailing display attribute. If either attribute is not explicitly specified in a field definition, the default for that attribute is N (normal). Output fields require neither leading nor trailing attributes; none are defaulted.

Full screen processing (continued)

Examples

The following displays a field as defined by line 10.

```
10 A$="5,7,C 18"
20 NAME$="JOHN DOE"
30 PRINT NEWPAGE
40 PRINT FIELDS A$: NAME$
50 B$="8,2,C 10"
60 INPUT FIELDS B$:DAK$
```

In this example, statement 40 will display the data on the fifth line of the screen, starting in column seven. The data item to be displayed is the character string "JOHN DOE". Statement 60 will input 10 characters from line 8, starting in column 2.

The following displays data on more than one line.

```
10 OPTION BASE 1
20 REM DISPLAY NAME AND ADDRESS
30 DIM FS$(3)
40 NAME$="JOHN DOE"
50 STREET$="125 1ST ST."
60 CITY$="CHICAGO IL"
70 FS$(1)="3,4,C 20"
80 FS$(2)="4,4,C 25"
90 FS$(3)="5,4,C 25"
100 PRINT NEWPAGE
110 PRINT FIELDS MAT FS$: NAME$, STREET$,CITY$
```

This example displays the first item of data (NAME$) on the third line of the screen, starting in column four. The second item of data (STREET$) is displayed on the fourth line of the screen, starting in column four, etc.

The following displays data and inputs data.

```
10 OPTION BASE 1
20 DIM A$(4), B$(3)
30 A$(1)="5,10,C 10,U,N"
40 A$(2)="10,4,C 5"
50 A$(3)="13,4,C 7"
60 A$(4)="16,4,C 5"
70 PRINT NEWPAGE
80 PRINT FIELDS MAT A$:"PROGRAMMER","NAME:",
   "STREET:","CITY:"
90 B$(1)="10,12,C 18,U,N"
100 B$(2)="13,12,C 18,U,N"
110 B$(3)="16,12,C 18,U,N"
120 INPUT FIELDS MAT B$: NAME$,STREET$,CITY$
```

See 'Appendix A'' programs 10, 11, and 12.

Programming considerations

- Number of fields
  - If an array is specified for FIELDS, the number of fields is the number of I/O list items, not the number of elements in the array. The number of elements in an array specified for FIELDS may exceed the number of I/O list items. The extra elements are ignored.
  - The maximum number of input fields is 128.

- Input attributes
  - When an INPUT FIELDS statement is executed, an implicit write to the display screen is generated to put out display attributes. The input fields are not modified.

Full screen processing (continued)

- Order
  - The fields defined in a FIELDS array may appear in any order.
  - The first element or field in a FIELDS array corresponds to the first I/O list item. The second element or field corresponds to the second I/O list item, etc.
- Enter
  - When the operator presses the Enter key, keyboard input ends and the input field values are processed. As each value is verified, it is assigned to an I/O list variable or array element. The number of I/O list items processed successfully is contained in the system variable CNT.
- Overlapped attributes
  - Input fields may not overlap. However, the location of the trailing display attribute of one field may be overlapped by the leading attribute of the following field. If leading and trailing attributes overlap, the last attribute written to the screen will be the one in effect.

- Mixed operations
  - Caution should be used when full screen processing is interspersed with non-full screen processing. There is no implicit clearing of the display screen when switching between the two. PRINT NEWPAGE may be used to perform this function. If the display screen is not cleared before full screen processing I/O, full screen processing fields will be interspersed with the previous contents of the screen. If the display screen is not cleared after full screen processing I/O, data and/or display attributes left on line 23 may cause a syntax error on the next operator entry.

Functions, defined

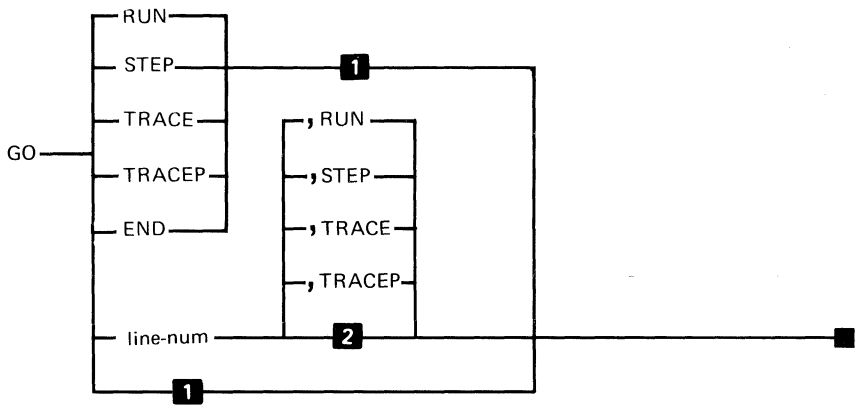
see "DEF, FNEND statement"

GO command

The GO command resumes or ends processing of a BÀSIC program or procedure.

If a program or procedure was halted, processing can be resumed by entering GO. Program execution may continue with any line specified in the GO command.

Procedure execution may continue with the next procedure line. In order to continue execution with another line, see "SKIP command".



1 Resume execution at the current line of the program or the next procedure line.
2 Remain in previous mode.

The syntax of the GO command is as shown, where:

line-num is the number of the line where processing of a program is to resume. If the number is omitted, processing begins with the line logically following the last line executed successfully, or the next procedure statement.

END specifies that all input and output files or the current procedure file are closed. After files are closed no program statements are executed (GO END is required for an interrupted program before issuing another RUN).

RUN specifies that processing is to continue in normal mode.

STEP specifies that processing is to continue in step mode (see "RUN command").

TRACE specifies that processing is to continue in trace mode (see "RUN command"). TRACE data is interspersed with screen data.

TRACEP specifies that trace messages are to be printed only. TRACEP should be used if tracing to screen would overwrite valid information.

Note: If neither RUN, STEP, TRACE, nor TRACEP is specified, processing will continue in the mode that was in operation when processing was interrupted.

If a line number is not specified, RUN, STEP, TRACE, or TRACEP is not preceded by a comma (,).

GO command (continued)

Examples

To change to normal mode or resume normal operation of a BASIC program:

GO RUN (then press Enter)

To change to STEP mode and begin execution at line number 620:

GO 620, STEP (then press Enter)

Programming considerations

- Resume
  - GO may only be used to resume processing and not to initiate processing (see "RUN command" to initialize processing).
- TRACEP printing
  - The data appears only when the line to be printed is full, the program generates a new line, or the printer is closed (when the program terminates).
- DISPLAY TRACEP
  - If the program is started by RUN DISPLAY, the TRACEP information will be directed to the screen.

For more information see "Split screen" and "TRACE statement".

GOSUB and RETURN statement

The GOSUB and RETURN statements are used together to invoke subroutines. The GOSUB statement transfers control to a specified statement. The RETURN statement transfers control to the first executable statement following the GOSUB statement that invoked the subroutine in which the RETURN occurs.

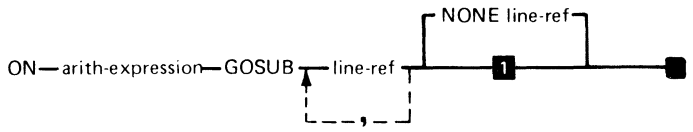
```
RETURN────────■

GOSUB──────────────── line-ref ──────────────■
```

The syntax of the GOSUB statement is either simple or computed. The simple syntax is shown above, where:

line-ref is the line number or label to which control is to be transferred.

Execution of a simple GOSUB statement causes transfer of control to the line or label specified. The maximum nesting level is 200.

GOSUB and RETURN statement (continued)



1 Interrupt occurs if the expression is out of range

The computed GOSUB syntax is shown above, where:

arith-expression is the arithmetic expression that determines the statement to which control is passed.

line-ref is a statement number or label. At least one statement number or label is required.

NONE if none of the line numbers preceding the NONE is selected, the line number following it is used.

Execution of a computed GOSUB statement causes the arithmetic expression to be evaluated. Control is then transferred to the line whose numeric position in the list of *line-num* (reading from left to right) is equal to the rounded integer value of the expression. Thus, an expression with a value of 2.75 would cause control to be transferred to the third line in the list. If the expression has a rounded integer value less than 1 or greater than the total number of lines listed, the program goes to the statement specified in the NONE clause. If a NONE clause is not specified, an error occurs.

When a GOSUB statement points to a descriptive statement such as DIM, control is transferred to the first executable statement following the descriptive statement.

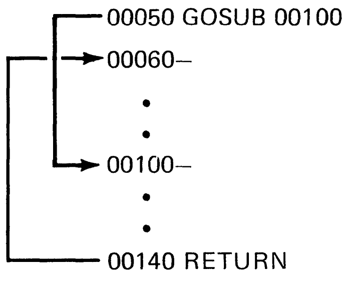
Programming considerations

Subroutines should be preceded by a GOTO to avoid falling through into them.

Example

The following example shows the execution of GOSUB and RETURN statements:

Simple GOSUB

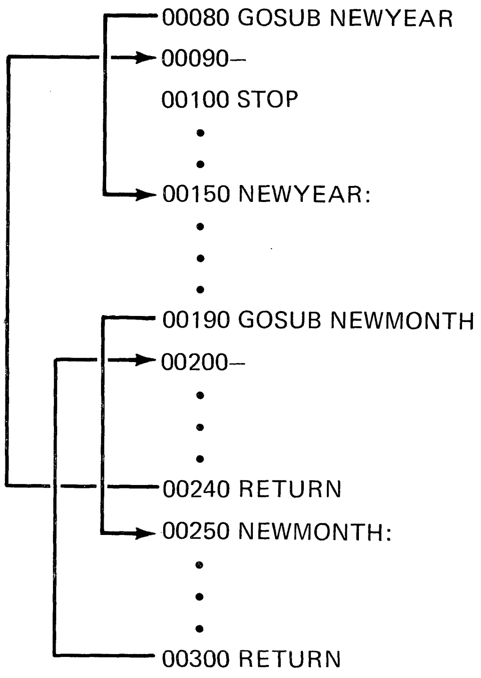


```
00050 GOSUB 00100
00060–
  •
  •
00100–
  •
  •
00140 RETURN
```

Program 1—Line 50 transfers control to line 00100, stacking line 00060 as a return location. Assuming no further transfers, lines 00100 to 00140 are executed and line 00140 transfers control to line 00060.

GOSUB and RETURN statement (continued)

Nested GOSUB



```
00080 GOSUB NEWYEAR
00090–
00100 STOP
  •
  •
00150 NEWYEAR:
  •
  •
  •
00190 GOSUB NEWMONTH
00200–
  •
  •
  •
00240 RETURN
00250 NEWMONTH:
  •
  •
  •
00300 RETURN
```

Program 2—Assuming no transfer statements other than those shown, the order of execution is: 00080, 00150 to 00190, 00250 to 00300, 00200 to 00240, 00090 to 00100(STOP).

An example of a computed GOSUB is as follows:

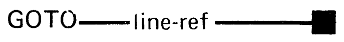
```
90 N=5
100 ON (C/N) GOSUB 150,280,370 NONE 420
```

```
IF C is 5, line 150 gains control.
IF C is 10, line 280 gains control.
IF C is 15, line 370 gains control.
IF C is less than 2.5 or greater than or equal to
17.5, line 420 gains control.
```

GOTO statement

The GOTO statement transfers control to a specified line or label.

The syntax of the GOTO statement can be simple or computed.

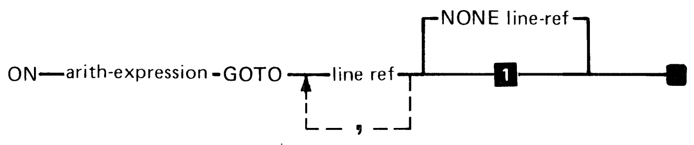


The simple GOTO syntax is shown above, where:

line-ref is the line number or label to which control is to be transferred.

Execution of a simple GOTO statement causes transfer of control to the line number or label specified.

The computed GOTO syntax is:



1 Interrupt occurs if expression is out of range

where:

arith-expression is the arithmetic expression that determines the line to which control is passed.

line-ref is a statement number or label. At least one statement number or label is required.

NONE if none of the line numbers preceding the NONE is selected, the line number following it is used.

Execution of a computed GOTO statement causes the arithmetic expression to be evaluated and control transferred to the line whose numeric position in the list of line numbers (reading from left to right) is equal to the rounded integer value of the expression. Thus, an expression with a value of 2.75 would cause control to be transferred to the third line in the list. If the expression has a rounded integer value less than 1 or greater than the total number of lines listed, the program goes to the statement specified in the NONE clause. If no NONE clause is present an error occurs.

When a GOTO statement points to a descriptive statement such as DIM, control is transferred to the first executable statement following the descriptive statement.

The following statement will transfer control to line number 20:

```
100 GOTO 20
```

The following statement will transfer control to the statement labeled RECOVERY when the variable LIMIT is 1.

```
100 ON LIMIT GOTO RECOVERY,500 NONE QUIT
```

HELP STATUS command (continued)

The HELP STATUS command displays the amount of space (in bytes) available in the work area, the work area type (PROGRAM or DATA), and the file specification of the last file used to load or save the work area.

```
HELP STATUS ────■
```

The syntax of the HELP STATUS is as shown. Between CLEAR or power on and LOAD/SAVE/REPLACE, only the mode and number of bytes available are reported.

Example

```
HELP STATUS

20168            PROGRAM  PAYROLL.FDP/PAYROL

(bytes avail)     (type)  (file specification)
```

HEX$(A$)

Returns a character string containing the hexadecimal value represented by the content of A$. For example:

```
10 A$="F1F2"
20 B$=HEX$(A$)
```

A$ must contain only the digits 0 through 9 or the uppercase letters A through F. The number of hexadecimal characters must be even.

B$ contains a two character string which is ''12''.

See''Hexadecimal table'' under ''Character set''.

Hierarchy, arithmetic

see ''Arithmetic hierarchy''

HOLD

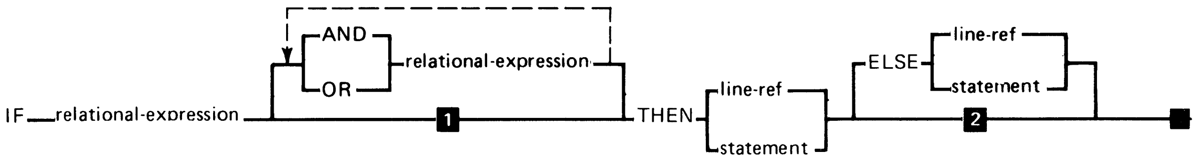
The HOLD key can be used to stop processing at any time (for example, to view the screen.) You press HOLD a second time to continue operation. Pressing the HOLD key will not immediately stop the printer.

If the 5322 Computer is sharing a 5246 Diskette unit, the second 5322 Computer may be stopped also. See ''Device sharing''.

If diskettes are removed while in the HOLD state, unpredictable results may occur.

IF, THEN, ELSE statement

The IF, THEN, ELSE statement transfers control according to the result of an evaluated expression or conditionally executes a statement.



1 One expression considered
2 If expression is false, go to next statement

The syntax of the IF, THEN, ELSE statement is as shown above, where:

relational expression is a relational expression or a logical operator (see "Relational expression" and "Logical operators" under this (IF, THEN, ELSE) statement).

line-ref is the line or label to which control is to be transferred. It is specified by either a line number or a label symbol.

statement is any of the following BASIC statements:

CHAIN	LINPUT	READ
CLOSE	MAT	REREAD
CONTINUE	ON	RESTORE
DELETE	ON GOSUB	RETRY
GOSUB	ON GOTO	RETURN
GOTO	OPEN	REWRITE
INPUT	PAUSE	STOP
INPUT FIELDS	PRINT	TRACE
LET	PRINT FIELDS	WRITE
LET (implied)	RANDOMIZE	

If CHAIN follows THEN, no ELSE clause is allowed.

The IF, THEN, ELSE statement either transfers program control or executes a statement according to the results of a relational or logical expression. If the expression is true and a line reference follows the THEN, control is transferred to that line. If a statement is specified, instead of a line reference, that statement is executed. If the expression is false and a line reference follows the ELSE, control is transferred to that line reference. If a statement follows the ELSE, that statement is executed. If the execution of this statement does not result in the transfer of control, or the ELSE was not specified, then control is passed to the next executable statement in the program.

IF, THEN, ELSE statement (continued)

Relational expression

A relational expression compares the value of two arithmetic expressions or two character expressions. The expressions are evaluated and then compared according to the definition of the relational function specified. The relational functions and their definitions are:

Relational function	Definition
=	Equal
<> or ><	Not equal
=> or >=	Greater than or equal
=< or <=	Less than or equal
>	Greater than
<	Less than

When comparing numeric values, the value compared is the full 15 digits of the representation. Results of functions which are not accurate to 15 digits should be rounded before making an equal compare. See "Accuracy" under "Arithmetic data". When character data appears in a relational expression, it is evaluated according to the collating sequence, character by character, from left to right. When character operands of different lengths are compared, the result is unequal. If all characters of the shorter string are character-by-character equal to the leading characters of the longer string, the shorter string is less then the longer string. Blanks are significant in comparisons.

Example

```
10 IF A=B THEN 90 ELSE 110
```

Logical operators, expressions

To form logical expressions, relational expressions can be combined.

Logical operators are used between relational expressions. When the logical operator AND is used between two relational expressions, the logical expression is true only if both relational expressions are satisfied. This is illustrated in the example that follows.

If OR is specified and the first expression is true, or if AND is specified and the first expression is false, the second expression will not be evaluated. For example, if the second expression contains a function, it will not be executed.

Examples

```
10 IF A$="JOB" AND B$="DATE" THEN 90 ELSE 110
20 IF MONTH=2 AND DAY=28 THEN MONTH=3 ELSE
DAY=DAY+1
```

In the following example OR is used to specify that either of the two relational expressions can compare in order for the logical expression to be true.

```
10 IF A=e OR B<4 THEN 90 ELSE 110
```

IF, THEN, ELSE statement (continued)

The following is an example used for checking a blank field:

```
100 IF B$=RPT$(" ",LEN(B$)) THEN GOTO BLANK

•
•
•
500 BLANK:STOP
```

The following examples show a variety of IF statements:

```
30 IF A(3)<>X+2/Z THEN 100
40 IF R$="CAT" THEN 70
50 IF S2=37.222 THEN 120
60 IF X>Y THEN 90
70 IF A<B OR C<D THEN 110
80 IF A$="JOB" AND B$="DATE" THEN 100
90 IF A=3 OR B=4 THEN C=G ELSE STOP
100 STOP
```

In line 40, for example, if character variable R$ contains the word CAT, program control is passed to line 70. In line 70, if either A<B or C<D, control is passed to line 110.

An example showing the use of labels is as follows:

```
30 IF MONTH=2 AND DAY=29 THEN LEAPYEAR ELSE LET
   MONTH=MONTH+1
•
•
•
70 LEAPYEAR:  LASTDAY=366
```

Programming considerations

- When an IF statement has a THEN clause and an ELSE clause, the THEN clause may not contain a MAT statement. For example, instead of doing this:

```
10 IF X=0 THEN MAT A=B ELSE MAT A=C
or:
10 IF X=0 THEN MAT A=B ELSE Y=10
```

Do this:

```
10 IF X=0 THEN MAT a+B
or:
10 IF X=0 THEN R=S ELSE MAT A=B
```

For other methods of examining data values, see "SRCH" and "POS".

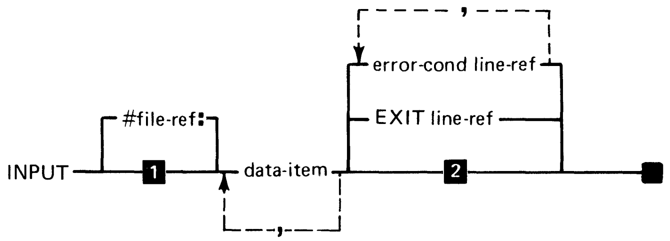
Index keys

see

"Create index file" under "Customer Support Functions"
"DELETE statement"
"KLN"
"KPS"
"OPEN statement"
"READ statement"
"REREAD statement"
"RESTORE statement"
"REWRITE statement"
"WRITE statement"

INPUT statement

The INPUT statement allows values to be assigned to variables from the keyboard (or procedure file) or a display file.



1 Defaults to #0
2 Interrupt on error unless ON is active

The syntax of the INPUT statement is as shown, where:

file-ref is a numeric expression, see "File reference parameter."

data-item is a simple variable, subscripted array element, or a MAT array name.

error-cond can be CONV, SOFLOW, EOF, IOERR (see "EXIT statement").

line-ref is either a line number or a label.

EXIT line-ref specifies the line number or label of an EXIT statement to refer to if an error occurs.

When an INPUT statement is executed, and input is expected from the keyboard, a question mark (?) is displayed on the screen on line 23, column 1 and the program execution halts. Input data is entered on the same line as the question mark. The data must be entered beginning in column 2 because column 1 is occupied by the question mark. You must then enter a list of values, that will be assigned in the order they are entered, to the variables listed in the INPUT statement or row-by-row to elements of specified arrays. The Enter key must be pressed to resume program execution. The number of values entered must be the same as the number of items in the I/O list.

INPUT is normally used to input data from the keyboard. However, it may also be used to read data (in keyboard entry format) from a diskette DISPLAY file (type 05).

Assignment of values occurs after each ENTER or record delimiter. If the PROC option is entered in the RUN command, values are supplied from the active procedure file (see ''Procedure file'') rather than from the keyboard. Each INPUT statement will get one line from the display file or procedure file. If the record supplies too many or not enough values for the data list, an error is indicated.

INPUT statement (continued)

Examples

To input:

A number or numbers.

```
10 INPUT X
20 INPUT X,Y
```

A string or strings.

```
10 INPUT N$
20 INPUT N$,A$
```

Numbers and strings.

```
10 INPUT NAME$,AGE
20 INPUT X,X$
```

From a file.

```
10 OPEN #100:"NAME=FILE.NAME",DISPLAY,INPUT
20 INPUT #100:ITEM1,ITEM2
```

An array (matrix).

```
CLEAR
10 OPTION BASE 1
20 DIM ITEM$(3)
30 INPUT MAT ITEM$
40 PRINT ITEM$(1),ITEM$(2),ITEM$(3)
50 END
```

The operator may respond to the following INPUT statement:

```
10 INPUT NAME$,AGE,ADDRESS$
```

in either of the following ways:

```
? Gabe, 25, Street
```

or:

```
? Gabe,
? 25,
? Street
```

Programming Considerations

- Blanks
  - The only blanks allowed within a numeric field are leading blanks or trailing blanks.
  - Enclose a character field in quotes if leading blanks, trailing blanks, or delimiters are significant.
- Data items
  - The data types and the number of data items are verified before any assignment takes place.
  - The maximum length of each character data item entered, is 255.
- Procedures
  - Specifying PROC on the RUN command has no effect on INPUT statements containing a file reference other than 0.

INPUT statement (continued)

- Command keys
  - Command function keys, when pressed during INPUT, cause input to end (same as pressing the Enter key) and CMDKEY variable to be set.

- Cmd/Attn
  - Pressing the Cmd/Attn key while INPUT is pending, will cause an interrupt when the current INPUT statement completes execution (after pressing Enter).

- LINPUT
  - The unformatted input of a character string is achieved by using the LINPUT statement (see "LINPUT statement").

- EOF
  - Input from a procedure (RUN PROC) can cause an EOF condition at the end of a procedure. An EOF clause should be coded to account for this. The program cannot revert to keyboard input when started by RUN PROC.

- Terminating input with a slash
  - If the input data is terminated with a slash (/), the number of data items entered can be less than the number of I/O list items. The values of any remaining I/O list items are left unchanged.

- CNT
  - If the input data is terminated with a "/," only items preceding the "/" are counted.
  - Each data item is counted as one.
    Example: 100,200,300,400 (CNT=4)

- Null entries
  - When constructing a DISPLAY file (type 05) for processing by INPUT, and the last data item can be a null character string, end each line with a slash (/). This will prevent a ''ends in comma'' error.

- Error conditions
  Preceding the assignment of any value, a check is made of all the data values entered. If the check fails at any point, none of the entered values are assigned. Some potential errors which can occur are:
  - CONV means that character data was provided when numeric data was required.
  - SOFLOW means that the character string input was too long.

See ''Sample program 5'' in ''Appendix A'' and ''Full screen processing.''

Inquiry key

see ''Attention and Inquiry''

Integer format

see

''Arithmetic data''
''INT(X)''

Internal constants

An internal constant is a named, pre-defined value. Unlike arithmetic variables, the value is never altered during program execution. An example of the only internal constant is:

Constant	Name	Value
pi	PI	3.14159265358979

The internal constant name can only be used as a part of an arithmetic expression. It cannot be the target of an assignment statement. For example (assume rounding is to 7 digits):

PRINT 2*PI (then press Enter)

The result will be 6.283185.

Internal files

see
  "Relative record files"
  "Key-indexed files"
  "Internal I/O files"

Internal I/O file formatting

Formatted (with USING)

When a WRITE or REWRITE statement contains a USING clause, the format of the data is specified by the associated FORM statement. The output record is generated in the following manner:

- Allocate a buffer of length specified by RECL= on the OPEN.
- Set the entire buffer to blank (hex 40). This applies to the WRITE statement only.
- Use the FORM specification and output data list values to fill in the specified record locations. Unspecified locations remain either blank or unchanged.

Unformatted (without USING)

When a WRITE or REWRITE statement does not contain a USING clause, the record is "unformatted". The output record is generated as follows:

- Allocate a buffer of length specified by RECL= on the OPEN.
- In the first two bytes of the record place the binary representation of the number of output list items. Each array element counts as one. The low order byte is first and the high order byte is second.
- Preceding each data value place the binary representation of the length of the data item. Numeric items are length 9 and character items are specified by their current length (0 to 255).

Internal I/O file formatting (continued)

- Following the item length, place the value of the data item in internal format. See "Arithmetic data" and "Character set".

The record length must have additional space allocated for these length fields over and above the aggregate length of the data. When numeric data items are expected, the length must be nine bytes. When character data items are expected, any length is acceptable. No type checking is performed.

Internal I/O files

Internal I/O files are used for collecting related numeric and character data items and storing them as a unit in a fixed-length logical record. These files must be opened before using the WRITE (or REWRITE) statement to store data items in the file and the READ (or REREAD) statement to retrieve data items from the file. Internal I/O files can be accessed sequentially or directly either by key-indexed or by relative record number. For specific information, see "Relative record files" and "Key-indexed files." See also "REC(N)" and "RLN(N)".

Internal representation of characters

see "Character set"

Internal variables

see "System variables"

Interrupt

An interrupt is a condition that stops execution of the program or the procedure. After the interrupt occurs, the program or the procedure is allowed to continue. For more information, see:

"Attention and Inquiry"

"EXIT statement"

"ON statement"

Interrupted programs may not be saved or replaced. DIM, OPTION, FOR, and NEXT statements may not be added or modified during an interrupt.

The *System Messages manual*, order number SA34-0141, contains a full description of action codes and error codes with the recommended actions.

Interrupt handling

BASIC program interrupts are:

- I/O errors
- Computational errors
- INQ key
- Cmd/Attn key

These interrupts are handled in the following priority:

- I/O errors with an applicable EXIT clause cause transfer to the specified line.

- Computational errors and I/O errors with no applicable EXIT clauses but with an applicable "ON condition GOTO" active, cause the specified transfer to take place.

- The INQ key is pressed and an ON ATTN GOTO is active. The INQ is detected prior to the execution of the next statement and the specified GOTO is executed. Note that Attn should be ignored when other conditions are being monitored by ON to prevent loss of one of the interrupts for RETRY and CONTINUE.

- Cmd/Attn cannot be intercepted and always causes an interrupt.

If no intercept (ON or EXIT) is specified for I/O errors, computational errors, or INQ key, an interrupt will occur.

For more information, see "ON statement", "Order of execution" and "Attention and Inquiry."

For a description of special handling of ON events and I/O exits within a defined function, see "DEF,FNEND statement."

Intrinsic functions

see "System functions"

INT(X)

Returns the largest integer not greater than X. For example:

```
10 X=-17.4
20 Y=INT(X)
```

Y contains -18

```
10 X=3.4
20 Y=INT(X)
```

Y contains 3

I/O action tables

The tables in Appendix B specify the response of System/23 to any combination of two I/O statements. Statements which are not listed on these tables are always considered errors. Refer to Appendix B for this information.

Keyboard

The keyboard is made up of alphabetic, numeric, and special character keys. Both uppercase and lowercase characters can be entered by using the shift key. The statement keywords and commands can be entered by using the Cmd key. When any of the keys are pressed, the characters entered appear in the input line on the display screen (see "Key description legend and tables").

Each of the keys are described in the *Operator Reference*, SA34-0108.

Keyboard-generated data files

A data file can be created directly from the keyboard by entering the CLEAR DATA command to clear the workarea and define it as data. Next the AUTO command may be entered to initiate automatic line numbering or lines may be entered preceded by a line number and a colon. The end of a data line is indicated when the Enter key is pressed. The only syntax restriction is the line number followed by a colon.

The length of the data file line may not exceed 249 characters. The workarea can be saved with the SAVE command. Data file lines are saved without line numbers or colons. They are saved in the DISPLAY file type (05). Procedure files are an example.

When data file lines are listed, the colon is displayed. Data in a keyboard-generated file can be accessed as a DISPLAY file during program execution or it may be a procedure file to control program execution. With line numbers and colons removed, the data file is accessed sequentially, one line at a time.

A saved data file can be changed by loading it back into the workarea with a LOAD DATA command. When saved, the line numbers and colon are again removed. When loaded, data lines are preceded by line numbers, starting with 00010 and incrementing by 10, and the colon.

Key description legend and tables

The key description, legend used in conjunction with the key description tables, describes the action taken for each key on the System/23 keyboard.

Key description table legend

The following is a legend of the symbols used in the key description tables.

A – Display lowercase graphic associated with the key pressed

B – Display uppercase graphic associated with the key pressed

C – Display alternate shift graphic associated with the key pressed

D – Display the command shift keyword associated with the key pressed

E – Build a value between 0 and 255. The last three keystrokes between pressing and releasing the alternate shift key are used to build the value. Treat the value as follows:

- $0 \leq \text{value} \leq 5$ – change the current CRT display page
- $6 \leq \text{value} \leq 63$ – sound the audible alarm, ignore the value

- $64 \leq value \leq 255$ – if the keyboard is open, display the EBCDIC character associated with the entered value; set KSTAT$; else ignore.

F – Set KSTAT$ to the value displayed.

G – Set KSTAT$ to the value that would have been displayed if the keyboard were open.

H – Set KSTAT$ to null.

I – Do nothing to KSTAT$.

J – When key is pressed, set case shift state to uppercase, set to lowercase when released.

K – When key is pressed, set case shift to uppercase. Do nothing when released.

L – When key is pressed, set data shift to command, when released, set data shift as follows:

- Alt (56) depressed (alternate)
- Alt (56) not depressed (normal)

M – When key is pressed, set data shift as follows, when key is released, set data shift to normal.

N – Do not alter data shift state.

Key description legend and tables (continued)

O – Terminate INPUT Statement.

P – Set CMDKEY to zero.

Q – Set CMDKEY to 1-9 according to key pressed.

R – Scroll rows 1-23 down one logical line. The last logical line on the screen is lost. If listing a program, the preceding line of the program will be displayed at the top of the screen if it will fit.

S – Scroll rows 1-23 up one line. If any part of the top logical line leaves the screen, blank the top logical line. If listing a program, the next line of the program will be displayed at the bottom of the screen if it will fit.

T – Enter ROS-resident diagnostics.

- Cmd/test causes error and action codes on status line.
- Cmd/Attn = diagnostic monitor.
- Error Reset = normal

U – Place machine in the Hold state. All processing stops. Processing resumes when Hold key is pressed again. Current I/O operations will run to completion. Copy Display is active in the Hold state.

V – Copy the contents of the display screen, including the status line, to the system printer, device 10. Copy Display is active when the keyboard is open for input and when the machine is in the Hold state.

W – When an error condition exists, terminate the error successfully.

X – When an error condition exists, terminate the error unsuccessfully.

Y – Set Basic flag for "ON ATTN" condition. If program doesn't trap, same as Cmd/Attn

Z – Blank from the current cursor position to the end of the logical line. Scroll down the display screen so that the cursor is now on the entry row. The cursor is in the same position relative to the start of the logical line being operated on.

a – Blank field from current cursor position to end of field.

b – Return control to the system command processor. If Basic is executing, control is returned before the next statement is executed. If a Customer Support Function or SORT is executing, control is returned at break points established by each function.

c – Move cursor to the first position of the next defined field. Cursor goes to first field if currently in the last field.

d – Move cursor to the last position of the previously defined field. Cursor goes to last field if currently in the first field.

e – If cursor is in a numeric field and field is not full, return an error. Otherwise, position cursor to row 23, column 1.

f – Move the cursor one position to the right (except for 'BE'-acute, '79'-grave, 'A1'-tilde, '5F'-circumflex, '9D'-cedilla, 'BD'-diaeresis).

Key description legend and tables (continued)

g – Move the cursor one position to the left.

h – Wrap to the next row when leaving the right side of the screen. Wrap to the beginning of the logical line if leaving the right side of the screen on the last row of the line.

i – If the cursor leaves the field that it is in, move it to the first position of the next defined field. Move to first defined field if currently in the last defined field.

j – Wrap to the previous row when leaving the left side of the screen. Wrap to the end of the logical line if leaving the left side of the first row of the line.

k – If the cursor leaves the field that it currently is in, move it to the last position of the previous defined field. Move to the last defined field if leaving the first defined field.

m – Move the cursor to the first position of the previous defined field. Move to the last defined field if currently in the first defined field.

n – Wrap to the next row of the logical line if the cursor moves off the screen to the right. If there is no next row, scroll up the screen by one row and put the cursor at row 23, column 1. If the logical line would be extended past 23 rows, sound the audible alarm and leave the cursor at row 23, column 80.

p – If the field is Automatic Field Exit, then **i**. If the field is Automatic Field Exit and Automatic Enter, then **O** and **P**. If the field is not Automatic Field Exit and the cursor would normally leave the field, put the keyboard into the Field Exit Pending state.

q – Move the cursor one position to the right for each character displayed in the command keyword.

r – Move all the characters, from and above the cursor to the end of the line, one position to the right. Put a blank above the cursor. If nonblank data on the last row is shifted off the screen, extend the logical line. If the line is already 23 rows, return invalid key error.

s – Move all the characters, from and above the cursor to the end of the field, one position to the right. If the last position is nonblank before the operation, return an invalid key error. Put a blank above the cursor if the operation is successful.

t – Move all the characters from, but not above the cursor to the end of the line, one position to the left. Blank the last position in the line. If the entry row becomes blank, scroll down the display screen one row.

u – Move all the characters from, but not above, the cursor to the end of the field, one position to the left. Blank the last position in the field.

v – If the last position and the first position in the field are non-blank, return an invalid key error. If the first position is blank, put a minus sign there. If the first position is nonblank, shift the entire field right one position and put a minus sign in the first position.

Key description legend and tables (continued)

w – If machine is in HOLD, enter C.E. monitor. If not, ignore.

Key description tables

These tables, used in conjunction with the key description legend, describe the action taken for each key on the System/23 keyboard.

Normal data keys: ~/ to $\overset{+}{=}$, Q to \\:, A to $\overset{)}{(}$, $\overset{>}{<}$ to ?/, space
Key numbers: 1-13, 16-27, 30-41, 43-53, 57

	Keyboard open for input		Keyboard closed
Shift	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	A, F, f, n	A, F, f, p	G
Upper case	B, F, f, n	B, F, f, p	G
CMD key	D, q, n	D, q, n	N/A
ALT key	C, F, f, n	C, F, f, n	N/A

± Copy D key
Key number: 13

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	A , F , f , n	A , F , f , p	G
Upper case	A , F , f , n	A , F , f , p	G
CMD key	V	V	V (press hold first)
ALT key	E	E	E

← key (cursor backspace)
Key number: 14

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	g , j	g , k	N/A
Upper case	g , j	g , k	N/A
CMD key	N/A	N/A	N/A
ALT key	N/A	N/A	N/A

Key description legend and tables (continued)

⇤ ⇥ Key (field advance, field backspace)
Key number: 15

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	O , P	c	N/A
Upper case	O , P	m	N/A
CMO key	N/A	N/A	N/A
ALT key	N/A	N/A	N/A

Enter key
Key number: 28

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	O , P	O , P , e	N/A
Upper case	O , P	O , P , e	N/A
CMD key	N/A	N/A	N/A
ALT key	N/A	N/A	N/A

⇩Key (shift lock)
Key number: 29

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	K	K	K
Upper case	K	K	K
CMD key	K	K	K
ALT key	K	K	K

⇧Keys (upper shift)
Key numbers: 42, 54

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	J	J	J
Upper case	J	J	J
CMD key	J	J	J
ALT key	J	J	J

Key description legend and tables (continued)

↵ Key (new line)
Key number: 55

	Keyboard open for input		Keyboard closed
Shift	**Result for normal mode**	**Result for full screen processing**	**Result**
Lower case (normal)	S	c	N/A
Upper case	S	c	N/A
CMD key	N/A	N/A	N/A
ALT key	N/A	N/A	N/A

Alt key
Key number: 56

	Keyboard open for input		Keyboard closed
Shift	**Result for Normal mode**	**Result for full screen processing**	**Result**
Lower case (normal)	M	M	M
Upper case	M	M	M
CMD key	N	N	N
ALT key	M	M	M

Field
Exit key
Key number: 58

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	O , P	a , c	N/A
Upper case	O , P	a , c	N/A
CMD key	N/A	N/A	N/A
ALT key	N/A	N/A	N/A

Erase
Attn key
Key number: 59

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	Z	a	N/A
Upper case	Z	a	N/A
CMD key	b	b	b
ALT key	Z	a	N/A

Key description legend and tables (continued)

Cmd key
Key number: 60

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	L	L	L
Upper case	L	L	L
CMD key	L	L	L
ALT key	L	L	L

Inq Key
Key number: 61

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	Y	Y	Y
Upper case	Y	Y	Y
CMD key	Y	Y	Y
ALT key	Y	Y	Y

Hold key
Key number: 62

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	U	U	U
Upper case	U	U	U
CMD key	U	U	U
ALT key	U	U	U

Error
Reset key

Key number: 63

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	N/A	N/A	W
Upper case	N/A	N/A	W
CMD key	N/A	N/A	X
ALT key	N/A	N/A	W

Key description legend and tables (continued)

Test key
Key number: 64

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	W	W	W
Upper case	W	W	W
CMD key	T	T	T
ALT key	W	W	W

⇟Key (scroll down)
Key number: 65

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	R	c	N/A
Upper case	R	c	N/A
CMD key	N/A	N/A	N/A
ALT key	N/A	N/A	N/A

⇞ (scroll up)

Key number: 66

	Keyboard open for input		Keyboard closed
Shift	**Result for normal mode**	**Result for full screen processing**	**Result**
Lower case (normal)	S	m	N/A
Upper case	S	m	N/A
CMD key	N/A	N/A	N/A
ALT key	N/A	N/A	N/A

←

Del key

Key number: 67

	Keyboard open for input		Keyboard closed
Shift	**Result for normal mode**	**Result for full screen processing**	**Result**
Lower case (normal)	g , j	g , k	N/A
Upper case	g , j	g , k	N/A
CMD key	t	u	N/A
ALT key	N/A	N/A	N/A

Key description legend and tables (continued)

→

Ins key
Key number: 68

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	f , h	f , i	N/A
Upper case	f , h	f , i	N/A
CMD key	r	s	N/A
ALT key	N/A	N/A	N/A

1-9 (ten key pad)
Key numbers: 71–73, 75–77, 79–81

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	A , F , f , n	A , F , f , p	G
Upper case	A , F , f , n	A , F , f , p	G
CMD key	O , Q	O , Q , e	G
ALT key	E	E	E

Field
- key
Key number: 74

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	N/A	a , v	N/A
Upper case	N/A	a , v	N/A
CMD key	N/A	N/A	N/A
ALT key	N/A	N/A	N/A

Field
+ key
Key number: 78

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	O , P	a , c	N/A
Upper case	O , P	a , c	N/A
CMD key	N/A	N/A	N/A
ALT key	N/A	N/A	N/A

Key description legend and tables (continued)

O key (ten key pad)
Key number: 82

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	A , F , f , n	A , F , f , p	G
Upper case	B , F , f , n	B , F , f , p	G
CMD key	N/A	N/A	N/A
ALT key	E	E	E

• Key (ten key pad)
Key number: 83

Shift	Keyboard open for input		Keyboard closed
	Result for normal mode	Result for full screen processing	Result
Lower case (normal)	A , F , f , n	A , F , f , p	G
Upper case	B , F , f , n	B , F , f , p	G
CMD key	N/A	N/A	N/A
ALT key	N/A	N/A	N/A

Key-indexed files

A key-indexed file is an Internal I/O file with an associated index file. The index file cannot be used by itself, it must be used with a master file.

The index file is created by using a Customer Support Function. You enter LINK INDEX to create the index.

The index includes a key, or set of up to 28 characters, used to identify each record and the associated relative record numbers. An index file cannot be DROPed.

Statements used to process a key-indexed file inlcude:

Statement	**Variation from Record I/O**
OPEN	KFNAME=key file name, access method=KEYED
READ	KEY="identifying characters"
WRITE	do not specify KEY=
REWRITE	KEY="identifying characters"
DELETE	KEY="identifying characters"

Key-indexed files (continued)

More than one index can be created for the same master file. For example, with a master file of names and addresses, there could be two different index files:

- One with zip codes used as the key.
- One with names as the key.

For more information see:

"OPEN statement"
"READ statement"
"WRITE statement"
"REWRITE statement"
"DELETE statement"

Keys

see
"Index keys"
"Keyboard"

KLN(N)

Returns the key length for file N. If the file is not open keyed, a -1 is returned.

KPS(N)

Returns the key starting position (byte number) for file N. If the file is not open keyed, a -1 is returned.

KSTAT$

Returns the character representing the key most recently pressed when the keyboard is not open. A reference to KSTAT$ sets it to a null string. See ''Key description legend and tables''.

Labels

Any BASIC statement (except a DEF statement) may be preceded by a label, which may be used in addition to a line number, to reference the line. The label is a one to eight character name with the same syntax as a numeric variable name (see ''Line numbers'' and ''Line reference''). A label may not be the same as a variable name or a reserved word (see ''Reserved words'').

Labels (continued)

Example

```
10 START: GOTO IT
 •
 •
 •
 500 IT:GOTO START ! ENDLESS LOOP
```

LEN(A$)

Returns the number of characters in A$, including blanks. For example:

```
10 DIM A$*100
20 A$="NUTS BOLTS SCREWS"
30 A=LEN(A$)
```

A contains 17

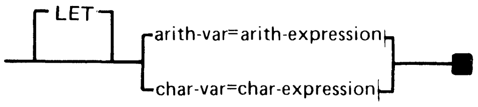
BASIC Language Reference
(Section Two)

IBM

System/23

LET statement

The LET statement assigns the value of an expression to a variable.



The syntax of the LET statement is shown above, where:

arith-var, char-var is a variable name, a subscripted reference to an array element, or a substring reference. The row and column references to an array element must be enclosed in parentheses.

arith-expression, char-expression must be an arithmetic expression when *var* is an arithmetic variable or an element of an arithmetic array. It must be a character expression if *var* is a character variable or array element, or a substring reference (see "Expressions").

When the LET statement is executed, the expression is evaluated and the resulting value is assigned to the specified variable.

Programming considerations

- Data values to the right of the equal sign must be of the same type as the variable to which they are assigned.

- The keyword LET is optional when entering assignment statements. When LISTing a program, LET will appear on all assignment statements.

LET statement (continued)

- Subscripted references to array elements are permitted in the assignment statement.

- Assignment of substring references are allowed.

Example

```
10 Z$ = "CAT"
20 X = 9
30 Y(X) = 2
40 A$ = B$(4:5)
50 A$ = A$&B$(3:4)
60 F$(X)(1:2) = B$(4:5)
```

After execution of line 10, the character variable Z$ will contain the word CAT. In line 20, variable X receives a value of 9.

After execution of line 30, the tenth element (default is BASE 0) of the one-dimensional arithmetic array (Y) will have a value of 2.

After execution of line 40, the fourth and fifth character of the character variable B$ will be assigned to A$.

After execution of line 50, the third and fourth characters of the character variable B$ are appended to the end of A$. A$ is increased by two characters.

After execution of line 60, the first two characters of the tenth element in array F$ are replaced by the fourth and fifth character of B$.

When line 10 is listed, it will appear as:

```
00010 LET Z$ = "CAT"
```

LINE

LINE is the system variable containing the line number where the last BASIC program error occurred. If no error has occurred it is zero. Nothing changes the value except another error.

See:

"CODE"
"ERR"
"Error handling"
"CONTINUE statement"
"RETRY statement"

Line control

see "SKIP parameter" under "PRINT statement"

Line numbers

Each line in a BASIC program and data file must begin with a unique line number. A line number is an integer from 1 to 99999 and tells the System/23 the line number location in a program or data file. Lines do not have to be entered in line number sequence. They can be entered in any order since they are automatically sorted by line number when they are stored. A line number must not be preceded by a blank. A BASIC program line number must be followed by a blank; a data file line number must be followed by a colon. For more information on line numbering, see "AUTO command" and "RENUM command."

Line reference

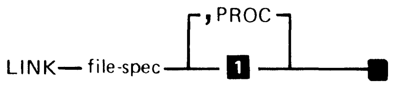
Each BASIC statement may be referred to in a program by either a label symbol (a name used to identify a line) or a line number.

Example

```
10 GO TO WORK
.
.
.
50 WORK: GO TO 10 !ENDLESS LOOP
```

LINK command

The LINK command loads and initiates the Customer Support Functions or Communications Access Method (see "Communication Guide").



1 Input will be from the keyboard

The syntax of the LINK command is as shown above, where:

file-spec is the file name, which might optionally include the volume ID and/or device ID (see "File specification parameter").

PROC is used to allow certain programs to read input data from procedure file.

The system returns to CLEAR status when the linked program is completed.

When the LINK command executes, the system transfers control to the function specified.

LINK command (continued)

Example

A sample LINK command is as shown:

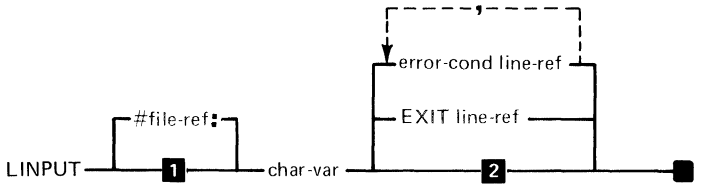
LINK COPY/VOL001

Upon execution of this command, the system will link to the COPY Customer Support Function diskette.

For more information on LINK, refer to *Customer Support Functions Volume II* under ''Using a Procedure File''.

LINPUT statement

This statement permits unformatted input of a character string from the keyboard (or procedure file) or from a display file. The character string may contain commas, semicolons, leading blanks, and/or other characters which are delimiters in INPUT statement data. After removing trailing blanks, the maximum length string LINPUT will process is 255 characters.



1 Default is #0
2 Interrupt on error unless ON is active

The syntax of the LINPUT statement is as shown above, where:

file-ref is an integer or numeric variable from 0 to 127 and must be preceded by the symbol # (number sign). See "File-reference parameter."

char-var is a character variable into which the characters entered in the input line will be assigned.

EXIT line-ref specifies the line number or label of an EXIT statement to refer to if an error occurs.

error-cond line-ref can be CONV, SOFLOW (see "EXIT statement"). line-ref is either a line number or label.

LINPUT statement (continued)

LINPUT can access data written with PRINT #n statement but not with a WRITE statement. LINPUT can also be used for saved data files or programs which were saved in SOURCE format.

When Enter is pressed, keyboard input is terminated. LINPUT can also be ended by pressing the Cmd key and a number pad key. The CMDKEY variable will be set to the number pressed.

Specifying PROC on the RUN command has no effect on LINPUT statements containing a file reference other than 0.

Pressing Cmd/Attn will cause an interrupt when the LINPUT statement completes execution.

If the data for LINPUT is provided from a procedure file (RUN PROC) and data is no longer available, an EOF condition will occur. An EOF can be coded in the LINPUT statement to prevent an interrupt. The program cannot revert to keyboard input when started by RUN PROC.

Example

```
90 DIM ADDR$*255
100 PRINT "Enter full address"
110 LINPUT ADDR$
```

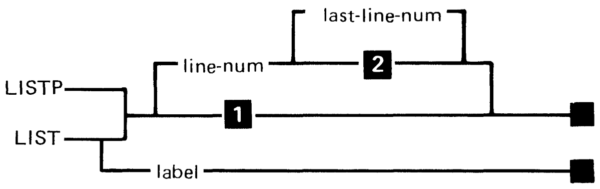
The full address can be entered as an answer.

See "Program 5—Sample" in Appendix A.

LIST, LISTP command

The LIST command displays the contents of the program or data in the workarea on the screen. The contents of the workarea are not changed.

The LISTP command prints the contents of the program or data in the workarea on the system printer. The contents of the workarea are not changed.



1 Screen - first 22 lines in workarea
Printer - entire workarea

2 Screen - 22 lines preceding and including line-num
Printer - line-num to end of workarea

The syntax of the LIST, LISTP command is as shown above, where:

label when specified with LIST causes the line with that label to appear on the last line of the display screen, the preceding line will be displayed also (as many as will fit on the screen).

line-num when specified with LIST causes that line to appear on the last line of the display screen, with as many preceding lines as can be contained on the screen being displayed above that line.

LIST, LISTP command (continued)

line-num specified with LISTP causes that line and all succeeding lines to be printed on the printer.

last-line-num specifies the last line number to be displayed or printed. It is used with *line-num*, and together they specify that the range delineated by the two line numbers is to be printed or displayed. That is, all the statements with line numbers between *line-num* and *last line-num*, inclusive, will be displayed or printed.

If no line number or range is specified, a range consisting of the entire program is used.

Programming considerations

- Cmd/Attn key
  - If the program is interrupted by Cmd/Attn or an error, LIST uses only the bottom five lines on the screen, while retaining the other display lines as they were (see "Split screen"). When execution resumes, the display screen is returned to the status it had when interrupted.

- Non-existing line numbers
  - If the line in the first *line-num* specification is not found, the next higher line number in the workarea will be used.
  - If the line in the last *line-num* specification is not found, the next lower line number in the workarea will be used.
  - If the label does not exist an error will occur.

- Long lines
  - If the line length exceeds the screen or printer width, the next line will contain the excess characters.

- Stopping LIST, LISTP
  - Since printer operations occur independently of other System/23 operations, the printer will not stop immediately when Cmd/Attn or Hold key is pressed. The printer will stop when all the information transferred to the printer has been printed.
  - The Cmd/Attn key is recognized only on a listing operation to the printer.

- Internal editing
  - When programs are listed, unnecessary blanks and parentheses will be deleted; line numbers will be expanded to five characters and LET will be inserted for implicit LET statement. For example:

    ```
    2 A = (B+C)
    ```

    will list as:

    ```
    00002 LET A = B+C
    ```

- Scroll
  - After LIST is issued the screen may be scrolled up to display the succeeding lines in the workarea. This can be done until either a line is entered or the scroll down key is pressed. Scroll down will not display any previous lines.

- Printer errors
  - Printer errors will not be reported until the next printer operation is attempted. The listing may be incomplete when a printing error occurs.

LIST, LISTP command (continued)

- Printing a program with the aid of LIST label
  - If you need a printed copy of the program, LIST label to the screen to determine the line number that label is on. Then use LISTP and specify that line number.

Examples

- LIST
  This will display the first group of workarea lines that fit on the screen.

- LIST 250, 99999
  This will display line number 250 and all succeeding lines that will fit on the screen.

- LIST 250
  This will display line number 250 and all preceding lines that will fit on the screen.

- LISTP
  This will print the entire program on the printer.

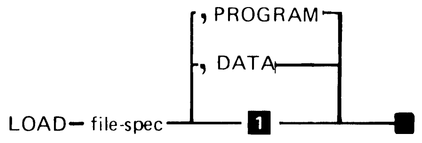
- LISTP 300, 500
  This will print line number 300 through line number 500 on the printer.

- LIST 20,20
  This will display one line number, line number 20.

- LIST ABC
  This will display the line with the label ABC and all preceding lines that will fit on the screen.

LOAD command

The LOAD command is used to load data in a display file (type 05), a program from a file into the workarea or Communications Customer Support Functions.



1 PROGRAM

The syntax is as shown above, where:

file-spec is the file specification parameter and is a file name followed by an optional volume-id and device address (see ''File specification parameter''). File type must be 05 (Display) or 09 (BASIC program).

DATA specifies that the workarea will be loaded from a file and each line will be assigned a line number. The file specified must be a type 05. Line numbers will begin with 10 and increment by 10, for a maximum of 9999 lines.

PROGRAM is the default. If DATA is not specified, the workarea will be loaded as a program from the file. No line numbers will be added since the program should already have line numbers. The file type must be 05 or 09.

Example

```
LOAD PROG1//1
LOAD DISPLAY.FILE,DATA
```

LOAD command (continued)

Programming considerations

- Cmd/Attn
  - A Cmd/Attn interrupt will not be honored during a LOAD operation
- Insufficient storage
  - If insufficient space is available in storage to load the file specified, an error occurs. Enter CLEAR to restart operations. The program must be separated into two or more programs.
- Performance
  - A type 05 (display) file takes longer to load as a program than a type 09 (program) file, because in a type 05 file each line is syntax checked, while it appears on the screen.
- Closing Files
  - LOAD will close all files left open by an interrupted program.
- LOAD commands
  - If LOAD PROGRAM is issued to a data file that contains valid commands or calculator statements (without line numbers) they will be executed and LOAD will continue.
- Syntax errors
  - If a syntax error occurs, the system is put into error correction mode. The line in error can be manually corrected at this point. No other errors are recoverable. Instead of correcting a syntax error, the CLEAR command may be entered to terminate the LOADing. If the incorrect line is to be skipped, scroll down to the previous correct line and press Enter.

Logarithm

see "LOG"

Logical expressions

see "IF, THEN, ELSE statement"

LOG(X)

Returns the natural logarithm (base e) of X. If X is not greater than zero an error is returned.

LPAD$(C$,X)

Returns a string of characters with a length greater than or equal to X by placing the required number of blanks before the first character of C$. For example:

```
10 C$="ABCD"
20 A$=LPAD$(C$,5)
30 B$=LPAD$(C$,2)
B$ contains "ABCD"
```

A$ contains " ABCD"

Note: An error will be generated if X is not in the 0 to 255 range.

LTRM$

LTRM$(C$)

Returns the string of characters contained in C$. Leading blanks are removed. For example:

```
10 C$=" AB CD"
20 A$=LTRM$(C$)
```

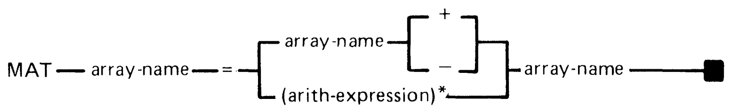
A$ contains "AB CD"

Magnitude

see "Arithmetic data"

MAT assignment (addition, subtraction, scalar multiplication)

The MAT assignment statement (addition, subtraction, scalar multiplication) adds or subtracts the contents of two arrays and assigns the results to a third array. Or, the statement multiplies the elements of a numeric array by the value of an arithmetic expression and assigns the resulting products to the elements of another numeric array.



The syntax of the statement is as shown above, where:

array-name is the name of an array.

arith-expression is the value to be assigned. When the expression is evaluated, each element is set to that value.

The corresponding elements of the arrays specified to the right of the equal sign are operated on and assigned to the corresponding elements in the array specified to the left of the equal sign. To assign the elements of one array to another array, see ''MAT assignment (simple).''

MAT assignment (addition, subtraction, scalar multiplication)

Programming considerations

- All arrays must be numeric
- All arrays specified in the statement must have identical dimensions

Example (addition)

The following shows execution of a MAT assignment (addition and subtraction) statement:

```
10 DIM X(2,2), Y(2,2), Z(2,2)
  .
  .
  .
100 MAT X=Y+Z
```

Each element of X now has the sum of the corresponding elements of Y and Z.

Example (scalar multiplication)

```
10 OPTION BASE 1
20 DIM X(2,2), Y(2,2)
__
__
__
100 MAT Y=(4)*X
```

The expression (4) is evaluated. Each element in array X is multiplied by the value of the expression (4). The result is assigned to the corresponding elements of the array Y.

The resulting values are:

If X = $\begin{array}{|c|c|}\hline 1 & 2 \\ \hline 3 & 4 \\ \hline\end{array}$ then Y = $\begin{array}{|c|c|}\hline 4 & 8 \\ \hline 12 & 16 \\ \hline\end{array}$

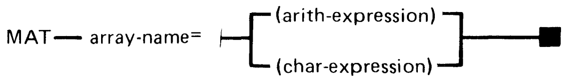
Each element of Y now contains four times the corresponding values in X. X is unchanged.

MAT assignment (ascending index or descending index)

see ''AIDX and DIDX''

MAT assignment (scalar value)

This statement assigns a specified scalar value to each element of an array.



The syntax of this statement is as shown above, where:

array-name is the name of the array that receives the values.

arith-expression is the scalar value to be assigned.

char-expression is the character value to be assigned.

Programming considerations

The expression to the right of the equal sign must be of the same type (arithmetic or character) as the array to which it is assigned.

Example

```
20 OPTION BASE 1
30 DIM Y(3,3)
40 MAT Y=(1)
```

The expression (1) is evaluated. Each element in the array Y is set to the value of the expression (1).

The resulting values are:

$$Y = \begin{array}{|c|c|c|}\hline 1 & 1 & 1 \\ \hline 1 & 1 & 1 \\ \hline 1 & 1 & 1 \\ \hline\end{array}$$

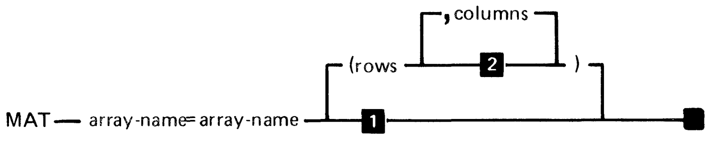
Y is now a 3x3 array with all elements equal to 1.

The following example causes all the elements of A$ to be null:

```
10 MAT A$=("")
```

MAT assignment (simple)

This statement assigns the elements of one array to another array.



1	No redimensioning
2	One-dimensional

The syntax of this statement is as shown above, where:

array-name is the name of the array. The arrays specified must be the same type (numeric or character)

rows, columns are the redimensioning specifications for the receiving array (see "Redimensioning arrays").

Example

```
20 DIM A(2,2), B(2,2)
—
—
—
100 MAT A=B
```

Each element of array B is assigned to the corresponding element of array A.

The result of the above example is, A and B now have the same values in corresponding elements.

If redimensioning specifications are included with array B, the rounded integer portion of each expression value in rows and columns is used to redimension the receiving array A, before values are assigned to it. Results are unpredictable if subscripted values are specified for rows and/or columns.

Programming considerations

- Redimensioning
  - If redimensioning specifications are included, rules described under "Redimensioning arrays" must be followed.
  - If redimensioning specifications are not included, arrays specified must have identical dimensions.

- Character arrays
  - If character arrays are used, the maximum character length of each must be the same.

Matrix

see "Arrays"

Matrix Operations

see
"AIDX and DIDX"
"MAT assignment (addition, subtraction, scalar multiplication)"
"MAT assignment (scalar value)"
"MAT assignment (simple)"
"ZER and CON"

Maximum Value

see
"Magnitude" under "Arithmetic data"

MAX (X1,X2,X3,...)

Returns the maximum value specified in the list. For example:

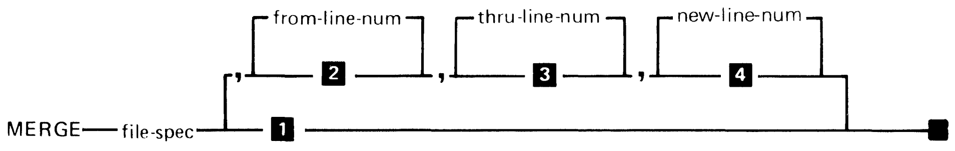
```
10 X=MAX(1,2,3,5,8,37,22,-21)
```

X contains 37

MERGE command

The MERGE command is used to merge all or part of a saved file with data or a program in the workarea. In this way, the same routine can be added to several different files. Only BASIC statements (in a BASIC source file) and DISPLAY DATA files can be merged (file type 05) into the workarea.

Lines from the file are added to the workarea in line number sequence. If a line from the file and a line in the workarea have the same line number, the line from the file replaces the workarea line. If the merged file exceeds the size of the workarea, an error message will be displayed.



1 Merge all lines
2 Defaults to 1
3 Defaults to 99999
4 Must be specified for data. May not be specified for program.

The syntax of the MERGE command is as shown, where:

file-spec is the name of the file to be merged into the workarea (see "File specification parameter").

from-line-num is the number of the first line in the saved file to be merged. If no number is specified, the first line in the file is the default.

MERGE command (continued)

thru-line-num is the number of the last line in the saved file to be merged. If no number is specified, the last line in the file is the default.

new-line-num is a parameter that is used only for DATA files and must be specified for DATA files. It is the first line number to be used in renumbering the saved file. If no number is specified, the merge will not take place. If a new line number is specified (for a data file), line numbering will be incremented by 10.

Omitted parameters must be indicated by consecutive commas.

Programming considerations

- Merging commands
  - If a program is merged and it contains commands or calculator statements, without line numbers, they will be executed.
- Exceeding workarea
  - If the merged file exceeds the workarea, an error message will be displayed.
  - If the workarea is full, issue a CLEAR.
  - Deleting lines will not increase the available storage, unless a SAVE SOURCE command and a LOAD command are performed.
- Renumbering
  - If renumbering is necessary for a PROGRAM file, the RENUM command must be used (see "RENUM command").

Example

```
MERGE PGM1,4,200
```

In this example MERGE command, statements from PGM1 are merged with statements in the workarea. Lines 4 through 200 will be merged.

```
MERGE DATAFILE,50,80,200
```

In this example, assume that the workarea is defined as a DATA workarea and that DATAFILE is a data file to be merged. The MERGE command logically associates line numbers (10, 20, 30, etc.) with the records in the data file. Line 50 is merged into the workarea as line 200. Line 60 is merged into the workarea as line 210. Line 70 is merged into the workarea as 220, and line 80 is merged into the workarea as line 230.

Minimum value

see "Magnitude" under "Arithmetic data"

MIN (X1,X2,X3,...)

Returns the minimum value specified in the list. For example:

```
10 X=MIN(1,2,3,5,8,37,22,-21)
```

X contains -21

Multiple line function

see "DEF,FNEND statement"

Names, variable

see "Variable names"

NEXT statement

see "FOR and NEXT statement"

Numeric data formats

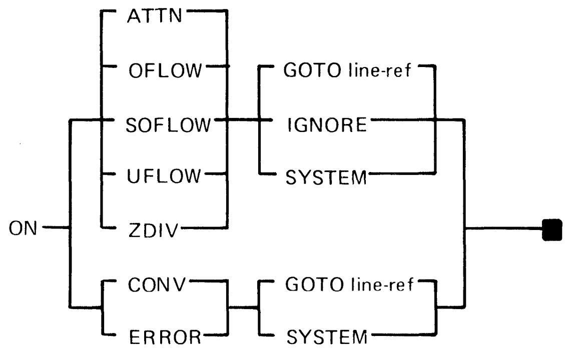
see
    "Arithmetic data"
    "FORM statement" (N specification)

Offline diskette files

If an application requires that files be open on more diskettes than can be inserted in the number of available drives, it can still function correctly, if the operator is present to insert the required diskette when the System/23 calls for it. This task is greatly simplified if all involved diskettes have unique VOLIDs to identify them. Each time the program calls for a file, the System/23 may already have the required data in storage or on an inserted diskette. If the program requires data from a diskette that has been removed, and the file is already OPEN, the status line shows code 4001 and action code 10. Remove the diskette from the specified drive (if one is inserted) and insert the required diskette; press Error Reset. If the file is not already OPEN, code 4000 and action code 10 are displayed. If a drive is specified, remove the diskette from that drive. If no drive is specified, select a drive and remove the diskette from it. Insert the required diskette and press Error Reset. In either case, if for any reason you cannot provide the required diskette, press Cmd/Error Reset and the error will be returned to the program.

ON statement

The ON statement causes the system to take a particular action when the specified condition occurs during execution of a program.



The syntax of the ON statement is as shown above, where:

ATTN is the condition associated with the depression of the INQ key. Control is passed following execution of the line in which the INQ key was pressed. ERR is set to 1 (see ''Attention and Inquiry''. For special considerations within defined functions, see ''DEF,FNEND statement'').

Note: Once the ON ATTN (inquiry) condition has been handled, CONTINUE will cause the program to resume at the point of interrupt.

OFLOW is the condition of numeric overflow. For example, an OFLOW error will occur when the system computes a number having an absolute value greater than the largest System/23 numeric value (see''Magnitude'' under ''Arithmetic data''). The result is replaced with plus or minus the largest System/23 numeric value.

SOFLOW is the condition of string overflow. For example, a SOFLOW will occur when there are more characters in the string than the variable has been dimensioned to hold, or the variable has more characters than the associated FORM specification. If IGNORE is specified, the string is truncated on the right. If SOFLOW IGNORE occurs on a substring assignment, or concatenation the error action is undefined; therefore no assignment will occur.

UFLOW is the condition of numeric underflow. For example, a UFLOW error will occur when the system computes a number having an absolute value less than the smallest System/23 numeric value (see "Magnitude" under "Arithmetic data"). The result is replaced with zero.

ZDIV is the condition of division of a non-zero value by zero. The result is replaced with plus or minus the largest System/23 numeric value (see "Magnitude" under "Arithmetic data").

CONV is the failure to map data or change representation. For example, a CONV error will occur when trying to put alphabetic characters into a numeric field.

ERROR applies to those errors not covered by any of the above clauses (for example, I/O errors). ERROR also applies to any of the above for which an ON statement clause is not specified.

GOTO specifies that control is to be passed to the line specified by the line number or label symbol.

IGNORE specifies that the condition is to be ignored and control passed to the next executable statement.

SYSTEM specifies that the condition is to cause an error.

ON statement (continued)

Programming considerations

- EXIT
  - I/O statements having error exit parameters generally override the ON statement (see "EXIT statement").
- ERR
  - If an error causes a transfer of control due to an ON statement, ERR is set and may be referenced
- Error routine
  - To prevent repeated entry into the error routine, the error routine should begin with an ON condition SYSTEM statement.
- CONTINUE and RETRY
  - The statement CONTINUE will return control to the point following the interruption (see "CONTINUE statement").
  - The statement RETRY will re-execute the statement causing the interruption (see "RETRY statement").

For more information, see "Order of execution", "Interrupt handling", "EXIT statement", "Attention and Inquiry," and "DEF,FNEND statement."

Example

```
10 ON CONV GOTO ERR1
 •
 •
500 ERR1:PRINT "Conversion error,reenter data"
510 RETRY
```

OPEN statement

OPEN DISPLAY
Activates a diskette file for input or activates a printer or diskette file for output

OPEN INTERNAL
Permits READ, REREAD, WRITE, REWRITE, and RESTORE statements to reference the file

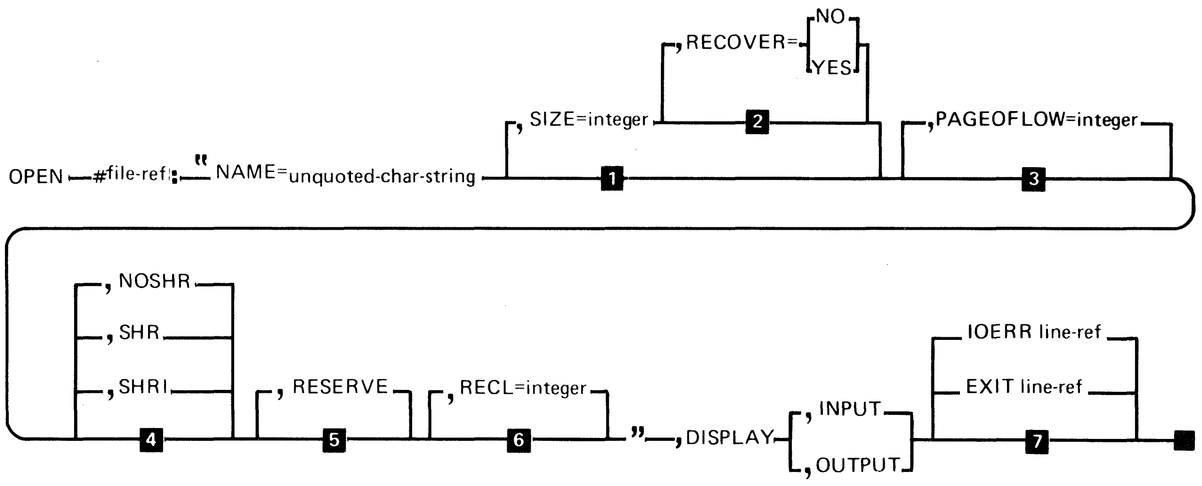
The OPEN statement is used to:

- Identify the file specification
- Assign a logical file reference
- Allocate initial space for new files
- Specify file usage
- Specify file type (DISPLAY or INTERNAL)

An OPEN statement must be issued for a file before any input or output accesses to that file.

OPEN statement (continued)

OPEN DISPLAY (syntax)



1	Old file
2	No backup label
3	Page length = 60 lines
4	No sharing allowed
5	Do not change old Reserve status
6	132
7	Interrupt on error unless ON ERROR is active

See "OPEN parameter table".

No blanks are allowed between a keyword and the equal (=) sign. The information in quotes is not syntax checked until the OPEN statement is executed. A character expression can be used in place of the information in quotes.

The syntax for OPEN DISPLAY is as shown, where:

file-ref is a numeric expression, see "File reference parameter".

NAME= specifies the file specification for the file to be opened. The form and content of the file specification is described under "File specification parameter."

SIZE= specifies the size, in bytes, of a new file to be created. The SIZE= parameter must be specified for a new file and must not be used for existing files. The value is rounded up to the next higher multiple of 512 and the space is permanently allocated to the file. If the specified file already exists, an error will occur. The default (SIZE=0) indicates 4096 bytes. DISPLAY files are dynamically extended.

RECOVER= YES specifies that an extra copy of the file label should be created and maintained. In case an I/O error occurs for this file, the extra label makes it easier to recover data (see "Customer Support Functions", "Recover Diskette").

RECOVER= NO specifies that an extra copy of the file label should not be created.

OPEN statement (continued)

PAGEOFLOW= specifies the line number which when printed or exceeded, a PAGEOFLOW condition will exist. When the line being printed is ⩾ the PAGEOFLOW value, a page overflow condition exists. The program may trap the PAGEOFLOW condition by specifying a PAGEOFLOW exit on a PRINT statement. Otherwise is ignored. Transfer of control to a PAGEOFLOW exit occurs after all lines have been printed. A PRINT #file-ref: NEWPAGE;; must be executed to prevent another overflow condition on the next PRINT and to reset the PAGEOFLOW counter to 0 (range 1–255). Default is 60.

SHR specifies that any supported level of file sharing with another OPEN statement is permitted. Two opens for OUTPUT or OUTIN are not supported.

NOSHR specifies that no sharing is permitted.

SHRI specifies that this OPEN statement permits sharing files with other OPEN statements for input only.

RESERVE specifies that the OPEN sharing status is to be permanently associated with this file and station. The RESERVE will be reset when a CLOSE statement specifying the RELEASE option is executed for this file. The RESERVE can also be reset using the PROTECT command.

RECL= specifies the number of columns per physical line of PRINT output, formatted or unformatted. Range: 1–255.

DISPLAY specifies that the file to be opened is either the printer or a type 05 diskette file.

INPUT specifies that data will be transmitted from the device using the INPUT or LINPUT statements.

OUTPUT specifies that data will be transmitted to the device using the PRINT statement.

EXIT specifies the line number or label of an EXIT statement to refer to if an I/O error occurs (see "EXIT statement").

IOERR specifies the line number or label to receive control if an error condition prevents the completion of the OPEN statement

OPEN statement (continued)

Example

```
100 OPEN #101:"NAME=PROC5/START,SIZE=512",
    DISPLAY,OUTPUT
```

The following example can be used to open a file whether it exists or not:

```
.
.
.
100 OPEN #1:"NAME=FILE/VOL,SIZE=1000",DISPLAY,
    OUTPUT IOERR EXISTS ! Assume new file
110 GOTO 150
120 EXISTS: IF ERR<>4150 THEN STOP
130 OPEN #1:"NAME=FILE/VOL",DISPLAY,OUTPUT
    ! Old file
140 RESTORE #1:
150 ————
```

To OPEN to the system printer, use device address 10:

```
110 OPEN #55:"NAME=//10,RECL=255",DISPLAY,OUTPUT
```

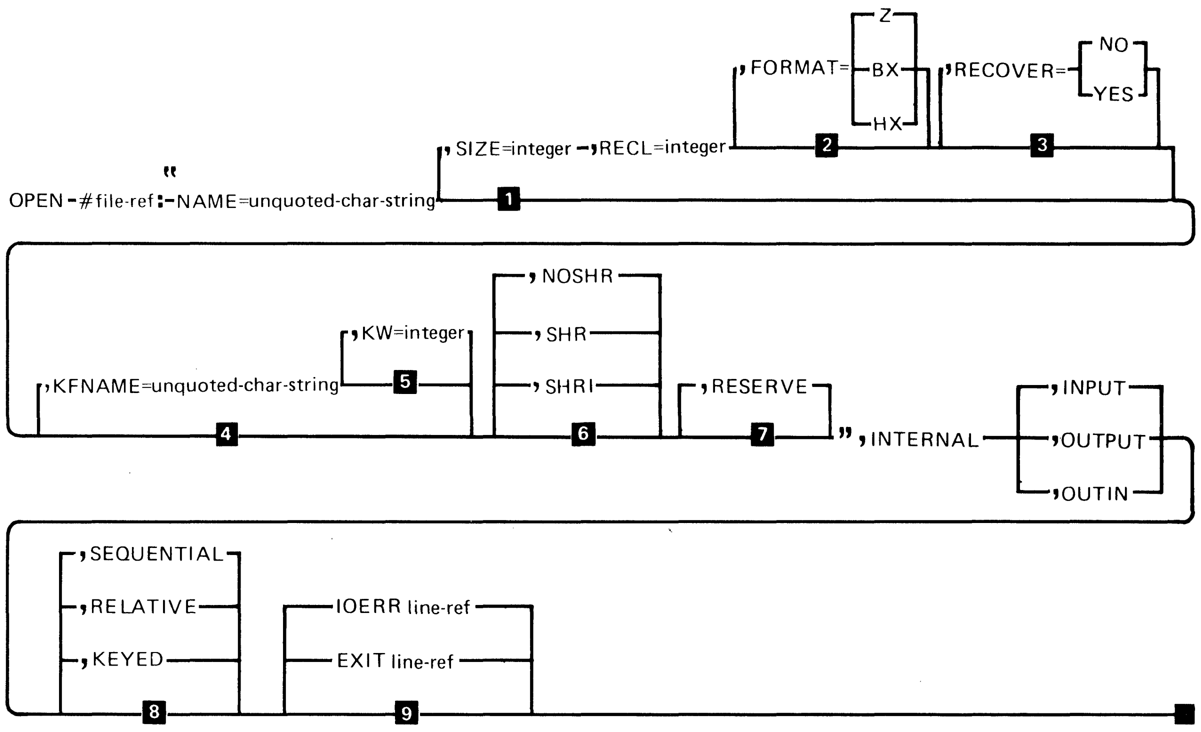
To OPEN to the feature printer (second printer), use device address 11:

```
120 OPEN #56:"NAME=//11,RECL=192",DISPLAY,OUTPUT
```

This is the only way to access the feature printer.

See "Device address parameter" and "File specification parameter".

OPEN INTERNAL syntax



1	Old file
2	Format = Z (System/23)
3	No backup label
4	Not key accessed
5	Key workarea = 0
6	No sharing allowed
7	Do not change old Reserve status
8	Sequential
9	Interrupt on error unless ON is active

See "OPEN parameter table".

OPEN statement (continued)

No blanks are allowed between a keyword and the equal (=) sign. The information in quotes is not syntax checked until the OPEN statement is executed. A character expression can be used in place of the information in quotes.

The syntax for OPEN INTERNAL is as shown, where:

file-ref is a numeric expression, see "File reference parameter".

NAME= specifies the file specification for the file to be opened. The form and content of the file specification is described under "File specification parameter."

SIZE= specifies the size, in bytes, of a new file to be created. The SIZE= parameter must be specified for a new file and must not be used for existing files. Size= is in multiples of 512 bytes. For example:

Size=1 through 512 specifies 512 bytes. Size=513 through 1024 specifies 1024 bytes. Size=1025 through 1536 specifies 1536 bytes. Size=1537 through 2048 specifies 2048 bytes, etc.

If the specified file already exists, an error occurs. The default (SIZE=0) is 4096 bytes. FORMAT=Z files are dynamically extended.

FORMAT= BX (Basic exchange file), HX (H Exchange file), Z (System/23). Z is the default.

RECL= specifies the record length of the file being created. RECL must be specified for a new file and cannot be specified for an existing file. The maximum values which can be specified for RECL are 128, 256, and 4096 for

FORMAT=BX, HX, and Z. For performance considerations, the following record lengths are recommended for FORMAT=Z files: 15, 31, 63, 127, 255, 511, 1023, 2047, and 4095. An example of an OPEN statement using SIZE= and RECL= is:

```
30 OPEN #1:"NAME=CUST//1,SIZE=0,RECL=127",
   INTERNAL,OUTPUT
```

For the Communications feature, the RECL parameter must be specified and represents the maximum record length for all data files transmitted or received throughout the communications session.

Maximum allowable record lengths are:

- Asynchronous communications, RECL=512
- Binary synchronous communications, RECL=128

RECOVER= YES specifies that an extra copy of the Data Set Label should be created and maintained.

RECOVER= NO specifies that an extra copy of the Data Set Label should not be created. RECOVER = NO is the default.

KFNAME= specifies the index file that is used to access the master file. This parameter is required when KEYED is specified. KFNAME is a file specification. See "File specification parameter."

KW= specifies the amount of workarea to be used for accessing key indexed files. If KW is not specified or assigned the value of zero, no workarea will be allocated.

OPEN statement (continued)

For optimum performance, see "Programming considerations" at the end of this OPEN statement.

SHR specifies that any supported level of file sharing with another OPEN statement is permitted. Two opens for OUTPUT or OUTIN are not permitted (see "File sharing").

NOSHR specifies that no sharing is permitted.

SHRI specifies that this OPEN statement permits sharing files with other OPEN statements for input only (see "File sharing").

RESERVE specifies that the OPEN sharing status is to be permanently associated with this file and station. The RESERVE will be reset when a CLOSE statement specifying the RELEASE option is executed for this file.

INTERNAL specifies that the file to be opened is a type 04 diskette file (see "Internal I/O files").

INPUT specifies that input operations are performed on the file.

OUTPUT specifies that output operations are performed on the file.

OUTIN specifies that both input and output (update) operations are performed on the file.

SEQUENTIAL specifies that the file being opened is to be organized sequentially or accessed consecutively. SEQUENTIAL is the default.

RELATIVE specifies that the file being opened is a relative data set. Access to the file is random and is by record number.

KEYED specifies that the file being opened is a key-indexed file. Access is made through reference to user-defined keys which physically exist within each record in that file, and in an auxiliary key file.

EXIT specifies the line number or label of an EXIT statement to refer to if an I/O error occurs (see "EXIT statement").

IOERR specifies the line number or label to receive control if an error condition prevents the completion of the OPEN statement.

Example

This example assumes that N$ and KFN$ contain the file specifications for the master file and key file:

```
10 OPEN #3:"NAME="&N$&",KFNAME="&KFN$,
   INTERNAL,OUTIN,KEYED
```

Programming considerations

- Positioning
  - INPUT and OUTIN files are positioned to the beginning. OUTPUT files are positioned to the end.
- BX and HX files
  - On an OPEN INTERNAL statement, if FORMAT=BX or FORMAT=HX is specified, file organization must be specified or defaulted to SEQUENTIAL:

  RECOVER=YES must not be specified; automatic file extension is not supported.

OPEN statement (continued)

- OPEN #0 and #255
  - OPEN #0 is ignored.
  - OPEN #255 statement may be executed to override the default value for RECL and PAGEOFLOW.

- Extents
  - If additional space is required, up to 99 extents are created. Each extent is SIZE divided by 10, rounded up to the next 512 byte multiple.
  - System/23 Format files (Z) will be dynamically extended if necessary.

- OPEN DISPLAY to the printer
  - If an OPEN DISPLAY is issued for the printer device, the file name or the VOLID in the file specification parameter will be ignored. The SIZE= and RECOVER= parameters cannot be specified.

- Record length
  - The record length of an internal file cannot be changed without first freeing the file and then recreating it.

- Device definition
  - If a new file is created (SIZE= parameter is specified) either VOLID or device address must be specified in the NAME= parameter.
  - If an old file is opened (SIZE= parameter is not specified) the VOLID and device address are optional.

- Implicit OPEN
  - The only implied OPEN statements are for the system printer (file reference 255), and the system keyboard/display (file reference 0).

- File searches
  - If an old file is opened and no VOLID or device number is specified, and there is more than one file by that name, the file residing on the lowest numbered diskette is opened (see "File searches").

- Key workarea size

KW	= Key workarea size
KL	= Key length
KS	= Keys per sector
NT	= Number of tracks
INT	= Integer system function
CEIL	= Ceiling system function
ST	= Number of sectors per track
NR	= Number of records (Master File)

The minimum useful workarea for an index file is 4+KL. To obtain the maximum useful workarea, specify KW=65535. The system will allocate only as much as it needs. The amount allocated by the system, when KW=65535 is specified, can be calculated as follows:

To find KS

KS = INT(512/(4 + KL))-1

To find NT

NT = CEIL(NR/(KS*ST)

ST = 8 for type 1 and 2 diskettes
 15 for type 2D diskettes

OPEN statement (continued)

To find KW

KW = 2+(NT*(KL+2))

Example:

KL = 10, NR = 10000, 2D diskette

KS = INT(512/14)-1 = 35 keys per sector

NT = CEIL(10000/(35*15)) = 20 tracks

KW = 2+(20*(10+2)) = 242 bytes

The upper bound for KW is:

4736 for type 2D and 2 diskettes

18848 for type 1 diskette

See ''Appendix A. Sample programs''.

OPEN parameter table

	Open internal		Open display		
	Diskette file		Diskette file		Printer
	(new)	(old)	(new)	(old)	
Name	R	R	R	R	R
filename	R	R	R	R	I
volid	O (1,5)	O (5)	O (1,5)	O (5)	I (5)
device	O (1)	O	O (1)	O	R
Size	R	(6)	R	(6)	E
Format	O	E	E	E	E
Recl	R	E	O	O (11)	O
Recover	O (2)	E	O	E	E
Kfname	E	O (3)	E	E	E
Kw	E	O (4)	E	E	E
Noshr	O (12)	O (12)	O	O	I
Shr	O (12)	O (12)	O	O	I
Shri	O (12)	O (12)	O	O	I
Reserve	O (12)	O (12)	O	O	I
Pageoflow	E	E	O	O (11)	O
Internal/display	I	I	D	D	D
Input/output/outin	R (9)	R	R (8,9)	R (8)	Output
Sequential/relative/keyed	O (7, 10)	O (7)	E	E	E
Exit	O	O	O	O	O
Ioerr	O	O	O	O	O

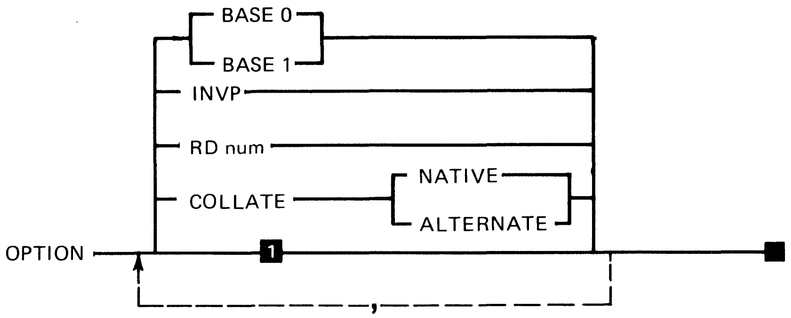
R = required O = optional E = error
I = ignored

Notes:

1. Either volume or device is required.
2. Applicable to FORMAT=Z only. For FORMAT=BX or HX, RECOVER=YES is an error. RECOVER=NO is ignored.
3. Required when KEYED specified.
4. Optional when KFNAME specified.
5. Specifying volid without filename is an error.
6. SIZE denotes a new file. SIZE must not be specified for an old file.
7. Specifying RELATIVE or KEYED for a FORMAT=BX or HX file is an error.
8. OUTIN is invalid on OPEN DISPLAY.
9. INPUT is invalid for new files.
10. KEYED is invalid for new files.
11. Ignored if file open for input.
12. Ignored for a FORMAT=BX or HX file.

OPTION statement

The OPTION statement specifies a set of options to be applied to the entire BASIC program. The OPTION statement may be placed anywhere in the program.



1 BASE 0
American format
Print all significant digits
Native

The syntax of the OPTION statement is as shown above, where:

BASE 0 specifies that there is a zero row/column to any matrix.

BASE 1 specifies that the matrix will start with 1 in the row/column.

For more information, see "Arrays."

INVP (inverted print) specifies that the decimal point and the comma are interchanged in the printing of numeric values (European format). This interchange of decimal point and comma affects the output from a PRINT or PRINT USING statement.

An example using PIC without INVP is: 123,456.78

The output with INVP is: 123.456,78

INVP also affects input using the N FORM statement data conversion specification. A comma in the input field will be treated as a decimal point.

RD num specifies how many rounded decimal digits are to be displayed to the right of the decimal point when a PRINT statement is executed. *nn* is an integer in the range 0 through 15.

If RD is not specified non-significant zeros will not be printed.

Note: RD affects only the printing of numbers. Internally the numbers do not change.

If RD 03 had been specified, 4.5678 would print as 4.568.

COLLATE NATIVE specifies the use of the system collating sequence, see "Character set".

COLLATE ALTERNATE specifies the use of the user specified sequence, see "Customer Support Functions" (change collating sequence,) "IF, THEN, ELSE statement," and "AIDX and DIDX."

OPTION statement (continued)

Programming considerations

- CHAIN
  - When chaining is performed, the options of the chained-to program must be the same as the chained-from program, see "CHAIN statement".

Order of execution

The order of execution of BASIC statements in System/23 is given by the following rules:

After RUN verifies the global characteristics of the program (for example conflicting DIMs or OPTIONs), execution begins with the lowest numbered executable line not in a defined function.

The next line to be executed is the next higher numbered executable line, unless:

- A GOTO, GOSUB, Function reference, RETURN, NEXT, IF, RETRY, or CONTINUE specifies the next line.
- END, STOP or CHAIN terminates the program.
- PAUSE interrupts the program.
- DEF transfers control to the first executable statement following the function.
- If a computational error is detected (SOFLOW, CONV, OFLOW, UFLOW, ZDIV) for which an ON. . .GOTO is active, the transfer takes place.
- If an I/O error is detected for which an EXIT is specified, transfer to the specified line occurs.
- If an I/O error, a computational error or INQ key is pressed and no applicable EXIT or ON condition GOTO is specified, or the Cmd/Attn key is pressed, the program interrupts.

See "Interrupt handling", "ON statement", "Arithmetic hierarchy".

For a description of special handling of ON events and I/O exits within a defined function, see "DEF, FNEND statement."

ORD(A$)

Returns the ordinal value of A$, where A$ has a length of 1 (the location in the collating sequence). This is affected by the Customer Support Function, Collating Sequence. See "OPTION statement".

Assume the native collating sequence.

```
A$ ="0"
```

ORD(A$) results in 240

See Appendix B and "Character set".

Overstruck characters

see "FORM statement" (SKIP 0)

Packed decimal

see "FORM statement" (PD specification)

PAD

see "LPAD$(C$,X)"
    "RPAD$(A$,X)"

Page overflow

See "OPEN statement"
"EXIT statement"
"PRINT statement"

Parameter, device address

see "Device address parameter"

Parameter, file reference

see "File reference parameter"

Parameter, file specification

see "File specification parameter"

PAUSE

PAUSE statement

The PAUSE statement interrupts program execution. It can be used for manually entering calculator operations or commands while execution of the program is suspended.

```
PAUSE ──────■
```

When a PAUSE statement is encountered during program execution, execution is interrupted and:

PAUSE

is shown on the status line with the line number of the PAUSE statement. To resume program operation, issue a GO command (see "GO command"). Statements must not be renumbered or a calling statement altered while the program is interrupted.

When PAUSE is encountered, the screen will be split and the bottom 5 lines will not appear. If the required function is simply to stop execution, LINPUT can be issued instead (see "Split screens", "LINPUT statement"). A PAUSE may not be included within a user defined function.

PIC$ (C$)

Returns the current currency symbol. C$, which sets the new currency symbol is optional. C$ must be one character in length. If PIC$ is not set by the program, it will be "$". This setting is changed by power up or by another PIC$ setting.

POS(A$,B$,X)

Returns the value of the first character position of a substring in A$ that matches B$.

X contains the character position in A$ where the search for B$ is to start. If the substring indicated by B$ does not occur in A$, zero is returned. For example:

```
10 A$="ABBCABCDE"
20 B$="BC"
30 P=POS(A$,B$,4)
```

P contains 6

PRINT BELL

see "PRINT statement"

Print control

see
    "Printer assignment"
    "PRINT statement"

Print data list delimiters

see "PRINT statement"

Printer assignment

When a printer is assigned, an association is made between it and a file reference number. A printer can be assigned to only one file reference number at a time. The following table shows the BASIC statements/commands which assign printers.

Statement/command	**File reference #**	**Device address (10 = system) (11 = feature)**
PRINT #255 statement executed in a BASIC program or in calculator mode. (See Note)	255	10
OPEN #n statement	file reference specified	device address specified
LISTP command	255	10
DIR n,PRINT	255	10
RUN TRACEP	255	10

Note: Except when the program was initiated by RUN DISPLAY.

A printer is released at the following times:

- when the RUN statement is entered (before BASIC program execution begins)
- when a CLOSE statement is executed to close a printer file
- when a BASIC program ends.

Programming considerations

- When a program is executed RUN TRACEP, the system printer cannot be opened to a file reference number other than 255.

- If the operator enters a PRINT #255 statement, LISTP, or DIR n,PRINT command while a BASIC program is interrupted, the system printer is assigned to file reference number 255. This will prevent the successful open of the printer to an alternate file reference number when BASIC program execution resumes.

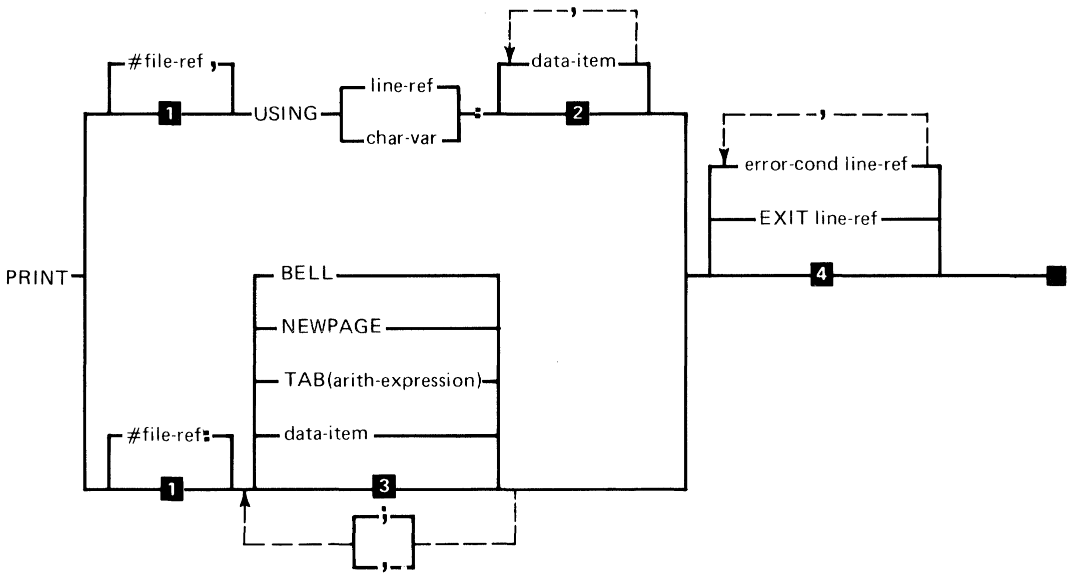
- Once the BASIC program assigns the system printer to an alternate file reference number, a PRINT #255 statement, LISTP, or DIR n,PRINT command entered by the operator while the BASIC program is interrupted will fail.

- In a BASIC program, when the system printer is assigned to file reference number 255, a "CLOSE #255:" statement will release it. It doesn't matter how the printer was originally assigned. If the system printer is not assigned, a "CLOSE #255:" is ignored.

PRINT statement

The PRINT statement causes the values of specified scalar expressions or arrays to be displayed or printed. All output is DISPLAY data.

The output of the PRINT statement can be directed to the screen, diskette file, system printer, or feature printer. In order to direct the output to the feature printer, file-ref must have been specified on an OPEN statement with device-id of 11.



1 #0
2 Use FORM statement
3 Null data item
4 Interrupt on error unless ON is active

The syntax of the PRINT statement is as shown, where:

file-ref is a numeric expression, see "File reference parameter."

USING must be either a line reference or a character variable. Line reference is the statement number or label of the FORM statement that defines how the data is to be formatted. Character variable is a character variable containing format information identical to that in a FORM statement.

data-item is one of the following:

- *MAT array-name* is the name of a one- or two-dimensional array. An example to print an entire array is:

```
50 PRINT #255: MAT ARRYNAME
```

- *"char-expression"* is a character expression (see "Character expressions").

- *arith-expression* is an arithmetic expression (see "Expressions").

BELL specifies the alarm will ring for .25 seconds.

NEWPAGE causes printing to begin on the next form, or clears the screen (see "NEWPAGE function").

TAB allows the alignment of columns of data (see "TAB function" in this section).

, (comma) if USING is not specified, the comma causes individual items to be printed in pre-established horizontal zones called print zones. Each zone is 24 character positions (see "Print zones" in this section).

PRINT statement (continued)

; semicolon as a delimiter, causes a null string (no extra blanks or spaces) to be printed between two groups of characters. (See "Print zones" in this section).

error-cond can be CONV, EOF, IOERR, PAGEOFLOW, SOFLOW (see "EXIT statement"). *line-ref* may be either a line number or a label symbol.

EXIT line-ref specifies the line number or label of an EXIT statement to refer to if an error occurs.

Programming considerations

- Printing arrays
  - When a PRINT statement is executed, each array element is converted to the output format and displayed. Each array is displayed in row order. For an unformatted PRINT each row begins at the start of a new line. Each array element is displayed or printed in succeeding print zones. Each element of a one-dimensional array begins on a new line.
  - For an unformatted PRINT, if an array is specified in the I/O list, no additional I/O list item or delimiter should follow.

- Formatted PRINT
  - When a PRINT USING statement is executed, the specified expressions or array references are evaluated. Their values are then edited into the corresponding format specifications in the specified FORM.

- Unformatted PRINT
  - Unformatted output consists of a PRINT statement with no USING clause. Spacing between displayed values is controlled by commas, semicolons, NEWPAGE, and TAB expressions.
  - When an unformatted PRINT statement is executed, the value of each specified expression is converted to the appropriate output format and displayed or printed in a left-to-right sequence, in the order in which it appears in the PRINT statement.

- Print zones
  - Each line that is printed or displayed is divided into print zones. Print zones are 24 character positions in length and are specified by the comma delimiter. For example:

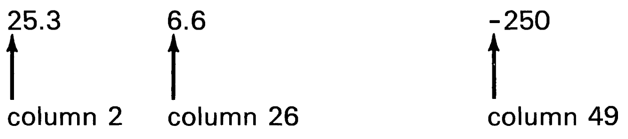
    ```
    200 PRINT A,B,C
    ```

    The above will cause the value of the variable A to be displayed beginning in the first position of the new line. Since A is a positive value, column 1 is a blank character. The value of B will begin in position 25 of the same line and the value of C will begin in position 49 of the same line. If a character value is longer than 24 characters it uses as many zones as necessary to accommodate it. If a character or arithmetic value will not fit in the space remaining on the line, it will start on the next line.

PRINT statement (continued)

```
160 A = 25.3
170 B = 66
180 C = -250
200 PRINT A, B, C
```

results in the following line being printed:



- Print data list delimiters
  - The meaning of comma, semicolon, and blank (ƀ), when used in data lists is shown in the following chart:

	Trailing	**Imbedded**
,	Same line, next zone	Same line, next zone
;	Same line, next character	Same line, next character
b	New line	Error

  - Trailing and imbedded refer to the location of the comma, the semicolon, and the blank in the PRINT statement data list.

- TAB function
  - The TAB (expression) function is used to align columns of data, in a manner similar to the TAB key on a typewriter. The TAB value must always be positive and if a non-integer, it is rounded. If TAB is negative, 1 is assumed. TAB(n) starts the next output in column n of the line. If the current position in the line is greater than n, data is put on the next line in position n.

- Printing data-items
  - *Character constants*-the actual characters enclosed in quotation marks are printed or displayed. In order to represent quotes, two consecutive quotes must be entered.
  - *Character variables*-the actual characters (excluding trailing blank) are printed or displayed.

- Numeric values
  - If OPTION RD is not specified and the value is between IE-6 and IE21, the number is printed in fixed format.
  - If OPTION RD is specified and the value is between IE-RD and (IE20-RD) the number is printed in fixed format. In all other cases floating format is used.

- NEWPAGE function
  - On the printer, NEWPAGE causes printing to begin on the next page or form. PRINT #255:NEWPAGE;; sets the overflow line counter to zero.

    On the display, NEWPAGE clears the screen and places the cursor in position 1 of line 23 (input line).

- Printer spacing and line control

PRINT statement (continued)

- For printer spacing, line control, vertical or horizontal density, use the following statement:

```
PRINT #255: HEX$("2B020500hhvvlp")
```

- All numbers must be represented in hexadecimal format. The numbers in parentheses below are hexadecimal numbers.
- *hh* (horizontal density) is the number of characters per inch. The number of characters per inch can be 10 or 15 (Hex 0A or 0F) only. The default value set by the system is 10 characters per inch (Hex 0A).
- *vv* (vertical density) increments of 1/96 inch per line feed. The minimum number specified is 8 (Hex 08) and the maximum number is 99 (Hex 63). The default value set by the system is 6 lines per inch (Hex 10).
- *lp* (lines per page) lines per page can be 1–255 (1–FF). The default value set by the system is 66 lines per page (Hex 42).
- Specifying 00 for the above values, hh, vv, or lp does not change the current setting. If a value outside the allowable range is specified, the power-on default is used.
- To turn quality print on/off, use the following statement:

```
PRINT #255: HEX$("2BD10705FFxxyy0000")  where

    xx (font) = 00, draft mode
                01, text mode

    yy (type style) = 00
```

- The default printer control values can be reestablished by another PRINT #255 statement specifying the defaults. The defaults are also reestablished when the printer is powered on. Neither the CLOSE statement nor program termination will reestablish the defaults.
- To prevent a blank line from being output when printer control values are printed, specify SKIP 0 on a FORM statement referenced by the PRINT statement. For example,

```
10 PRINT #255,USING 20: HEX$("2B0205000A1042")
20 FORM C 7,SKIP 0
```

- Specify #255 for the system printer. The file reference number to be specified for a feature printer is the file reference number associated with that printer in the OPEN statement.
- During quality print mode, the horizontal density cannot be changed. See ''Full screen processing.''

Print zones

see ''PRINT statement''

PROC command

The PROC command initiates the use of a procedure file (see "Procedure file"). A procedure file is a DISPLAY (type 05) file on diskette that can contain system commands, BASIC statements, and data. A procedure file allows the programmer to set up the steps necessary to load and execute a series of BASIC programs (including data entry) without the need for operator intervention. For example, commands such as LOAD and RUN can be entered by executing the lines of a procedure file containing these commands. The lines of a procedure file are executed one line at a time, just as if they were entered from the keyboard.

```
PROC—file-spec ————■
```

The syntax of the PROC command is as shown above, where:

file-spec consists of a file name followed by an optional volume identification and device address. A procedure file must be a type 05 file previously created and stored on a diskette. For more information about file types, see "Diskette file types." For the methods used to create this type of file, see "Procedure files."

When the PROC command is executed, the file with the specified ID is accessed for procedure file data. The PROC command implicitly opens the procedure file.

See "Sample programs 8 and 9" in "Appendix A"

Procedure file

The procedure file is a DISPLAY (type 05) diskette file. A procedure file can contain commands, statements, and data to be used by the program for input.

Creating a procedure file

A procedure file can be created in two ways:

- From the keyboard using the CLEAR DATA command, followed by entering data lines containing commands. Data lines are preceded by a line number followed by a colon. After the file has been entered, it must be saved.

- Under program control using the OPEN DISPLAY statement. The file is written using PRINT statements, followed by a CLOSE statement.

Modifying a procedure file

As with any display file, a procedure file can be loaded as a data file and then modified or edited from the keyboard. The RENUM and AUTO commands can be used to allow entry of new lines.

Executing a procedure file

Use of a procedure file is initiated by a PROC or a SUBPROC command, which causes the file to be opened implicitly. Procedure files can also be called in a program by the CHAIN statement. Lines from the file are executed as if they were entered from the keyboard. (See "PROC command", "SUBPROC command", and "CHAIN statement.")

Procedure file (continued)

Closing a procedure file (after executing)

- The procedure file remains open while the procedure is active.
- It is closed by:
  - a PROC command embedded within the procedure that calls another procedure
  - issuing a CLEAR PROC command from the keyboard
  - an End Of File
  - GO END if no program is active
- A procedure can be exited by specifying SKIP integer, where integer is a number larger than the number of lines remaining in the procedure.

  A procedure can also be exited by issuing a GO END command from the keyboard when the procedure is interrupted.

Nesting a procedure file

Procedures may be nested by use of the SUBPROC command to a level of five active procedures/subprocedures. Procedures may provide input to Customer Support Functions.

SKIP

The SKIP command allows selective use of the lines in the procedure file (see ''SKIP command'').

ALERT

The ALERT command tells the operator that intervention is needed during execution of the procedure file (see ''ALERT command'').

Data

Data in a procedure file can also be used as input supplied in response to an INPUT or LINPUT statement (see ''INPUT statement'', ''LINPUT statement'', and ''RUN command''). This is achieved by coding the PROC parameter in the RUN command.

Interrupting

If Cmd/Attn is pressed during execution of a procedure file, it will be handled the same way as if an ALERT command had been encountered. Upon return to the procedure, the keyboard is opened before the next PROC command is executed. For more information, see ''ALERT command'' and ''GO command.'' In both cases, enter GO to continue.

Storage

Each procedure file activated by a PROC or SUBPROC requires about 200 bytes of storage. The first requires 500 additional bytes.

Procedure file (continued)

Example

```
CLEAR DATA
10: LOAD PROG1
20: RUN
30: LOAD PROG2
40: RUN
50: ALERT INSERT PAYROLL DISKETTE THEN ENTER GO
    •
    •
    •
SAVE PAYROLL.PROC//2
```

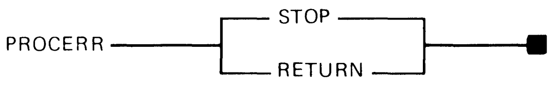
In order to execute the procedure, the command PROC PAYROLL.PROC is entered.

PROG1 will be loaded and executed, then PROG2 will be loaded and executed. The ALERT message will then be displayed on the screen and the execution of the procedure will stop.

For more information about PROC, refer to *Customer Support Functions*, Volume II under ''Using a procedure file''.

PROCERR command

The PROCERR command is a procedure file command that directs the system error handling mechanism either to return errors occurring in commands or untrapped in BASIC programs to the procedure file or report them to the status line.



The syntax of the PROCERR command is as shown above, where:

STOP specifies that errors are to be reported to the status line. Pressing Error Reset, Cmd/Error Reset, or Cmd/Attn at this time, opens the keyboard for input.

RETURN specifies that the next procedure file record is to be executed.

The PROC command sets the PROCERR option to STOP when issued with no procedure files active. Thereafter, the option may only be reset with the PROCERR command. The most recently issued PROCERR command from any level of procedure file nesting always controls the PROCERR option. The PROCERR command may be issued from the keyboard to alter the option when a procedure file has been interrupted (as by Cmd/Attn). This PROCERR will be considered the most recent until another PROCERR is issued.

The PROCERR RETURN command sets the value of the ERR variable to zero.

PROCERR command (continued)

When the RETURN option is in effect, the next procedure file record is executed in command mode and the procedure continues. This should always be a SKIP command, which tests the value of the ERR variable, unless the error can be totally ignored (see examples).

Examples

<u>PROCFILE.A</u>

```
PROCERR RETURN !REGAIN CONTROL IF NO FILEXXX
FREE FILEXXX/VOLXX
PROCERR STOP !GOTO STATUS LINE IF LOAD/RUN FAILS
LOAD FILEYY.PGM
RUN
```

<u>PROCFILE.B</u>

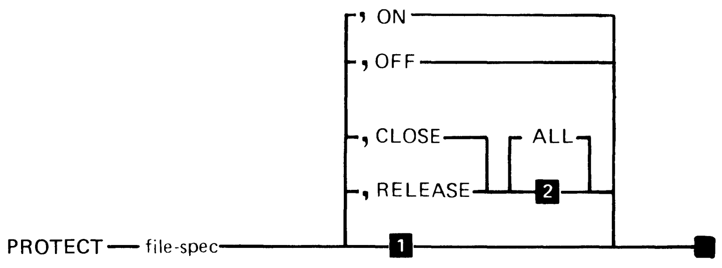
```
PROCERR RETURN
LINK COPY !COPY FILE1 TO FILE2
●
●
●
SKIP 2 IF ERR=0 !IF COPY SUCCESSFUL CONTINUE
ALERT COPY FAILED
```

PROCIN

Indicates whether input is from the screen (0) or from a procedure file (1).

PROTECT command

The PROTECT command is used to control the integrity of data in a diskette file by write-protecting the file. It can also be used to mark a file label as closed that has been left marked open or to RELEASE a file that has been reserved (see "DIR command" and "Diskette file sharing").



1 ON
2 CLOSE or RELEASE for this station only

The syntax of the PROTECT command is as shown above, where:

file-spec consists of a file name followed by an optional volume-id and device address. For more information see "File specification parameter."

ON specifies that a file is to be write-protected.

OFF specifies that write protection is to be removed from a file that is currently write-protected. If none of the optional parameters are specified, ON is assumed.

CLOSE specifies that a diskette file label is to be updated to show that the file is not open for this station.

PROTECT command (continued)

RELEASE specifies that a diskette file label is to be updated to show that the file is not open and that no reserved control status is in effect for this station.

ALL specifes that the CLOSE or RELEASE parameter applies to all stations that are part of the System/23. RELEASE ALL can affect data integrity if the other station is using the file.

Write protection prevents REWRITE, WRITE, PRINT, REPLACE, DROP, or FREE to a file. Write protection also prevents COPY (Customer Support Function) to the file.

CLOSE, RELEASE, and ALL are ignored for Basic-exchange and H-exchange diskettes.

Do not use PROTECT CLOSE or PROTECT RELEASE unless you are sure the file is not in use.

Examples

PROTECT LOSSES

In the example, the LOSSES file will receive write protection, which ensures that other data cannot be written into the file.

```
PROTECT SCREEN.FILE,CLOSE ALL
```

The example shows how to mark as closed the file label of a file named SCREEN.FILE that has accidentally been left marked open by another station. Use the DIR command and check the status of the *file share indicator* to see if a file has been left open (see "File sharing").

RANDOMIZE statement

The RANDOMIZE statement is used to initialize the random number generator, used by the RND function, to a new value (called a *seed*). The next reference by the RND function produces an unpredictable number in the range from 0 to 1.

```
RANDOMIZE ────■
```

The syntax of the RANDOMIZE statement is shown above. For more information, see "RND(X)." When RANDOMIZE is not used, the function RND provides the same sequence of numbers each time the program is run.

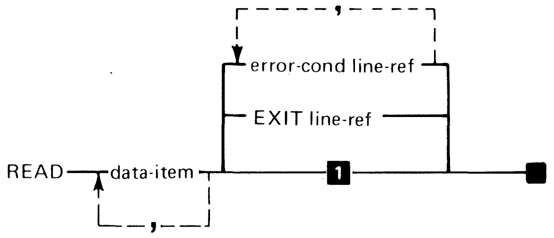
Random numbers

see
"RANDOMIZE statement"
"RND(X)"

READ statement (with no file reference)

The READ statement is used to read data from the internal data table created by DATA statements and assigns that data to variables, arrays, or array elements. (See "DATA statement.")

To assign values from a record in a file (record I/O) to specified variables or arrays, see "READ statement (with file reference)."



1 Interrupt on error unless ON is active

The syntax of the READ statement is as shown above, where:

data-item specifies the names of variables to be read into from the data table. Data items can include variables, array elements, or entire arrays (preceded by MAT). The data items must be separated by a comma.

error-cond line-ref specifies the line number or label that the program should transfer to if one of the error conditions occurs. The following error conditions may be included:

- CONV - conversion error

- EOF - an attempt to read more data than provided by DATA statements.
- SOFLOW - string overflow

See "EXIT statement" for more information on these error conditions.

EXIT line-ref specifies the line number or label of an EXIT statement that the system should reference if an error occurs.

At the beginning of program execution, a pointer is set to the first value in the internal data table specified by one or more DATA statements.

When a READ statement is encountered, successive values from the internal data table are assigned to variables and arrays in the READ statement beginning at the current data file position.

Example

```
CLEAR
10 OPTION BASE 1
20 DIM D(5)
30 DATA 5,10,15
40 READ A,B,C,MAT D
50 DATA 1,2,3,4,5
```

The values in the DATA statement are assigned in the same order to the variables listed in the READ statement. Once the READ and DATA statements are executed, A is equal to 5, B is equal to 10, C is equal to 15, and the five elements of array D are 1, 2, 3, 4, 5.

READ statement (with no file reference) (continued)

Programming considerations

- Character assignments
  - The length of the character data item being read determines the length of the character string assigned to the character variable.

- Numerical assignments
  - A string of digits not in quotes may be read as a number or a character string, depending on the variable type.

- Array assignments
  - The array references in the data-item list are assigned values from the data file by rows, starting at the current data file position.

- Truncation
  - If the numeric data exceeds 15 digits, truncation will occur.

- Error conditions
  - A numeric data value was read and the READ statement specifies a character data item.
  - The data file is exhausted or no DATA statements exist in the program and unassigned data list items remain in the READ statement (EOF).
    If a READ statement is executed and there are no DATA statements in the program, an error will occur.
  - The absolute value of a numeric data item is greater than the largest System/23 numeric value (see "Magnitude" under "Arithmetic data"). An overflow condition is generated.

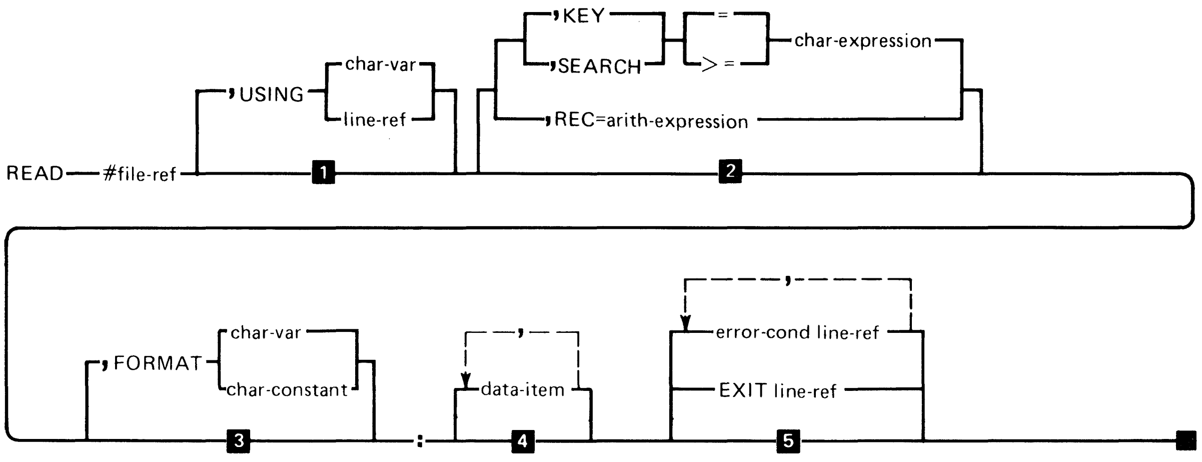
  - The absolute value of a numeric data item is less than the smallest System/23 numeric value (see "Magnitude" under "Arithmetic data"). An underflow condition is generated.
  - The data that is read exceeds the length of the data item (SOFLOW).

- BASE

  If the default (BASE 0) is in effect, an array DIMed to size N requires N + 1 elements. See "DIM statement" and "OPTION statement."

READ statement (with file reference)

The READ statement assigns values from records in a file to specified variables or arrays.



1 Unformatted READ
2 Read next sequential record
3 Communications feature not in use
4 Read record, do not use data
5 Interrupt on error unless ON is active

The syntax for the READ statement is as shown above, where:

file-ref is a numeric expression. See "File reference parameter."

USING specifies a *line-ref* (line reference) of a FORM statement or a *char-var* (character variable) containing a FORM statement. *Line-ref* can be a line number or label. The FORM statement is used to indicate the representation and location to be assigned to the variables in the data-item list that will be read. If no USING is specified, unformatted read will be performed. See "Internal I/O file formatting."

KEY specifies the key field used to access the record in the file. The character expression must be the same length as the key field.

SEARCH specifies the key field used to access the record in the file. The character expression can be less than or equal to the length of the key field. If the character expression is shorter in length than the key field, the search of the index will consider only that part of the key field equal to the length of the specified character expression.

= specifies that the KEY/SEARCH argument must make an exact match to the record key.

>= specifies that if an equal compare is not made, the next record in the key sequence following the provided key is used.

REC=arith-expression is a positive, nonzero integer or numeric variable that specifies the logical record number of the record to be retrieved. If this parameter is not specified, the next logical record will be accessed.

data-item specifies the name(s) of variable(s) to be read into from the file. Data items can include elements, or entire arrays (preceded by MAT). The data items must be separated by a comma. The first data item must be preceded by a colon.

error-cond line-ref specifies the line number or label that the program should transfer to if one of the error conditions occurs. The following error conditions may be included in any order:

READ statement (with file reference) (continued)

- CONV—conversion error
- EOF—end of file
- IOERR—input/output error
- NOKEY—key not found; invalid key reference
- NOREC—no record found; invalid record reference
- SOFLOW—string overflow

See "EXIT statement" for more information on these error conditions.

EXIT line-ref specifies the line number or label of an EXIT statement that the system should reference if an error occurs.

FORMAT is a Communication feature clause. It specifies that special control functions are requested. The control functions can be specified as a *char-constant* (character constant) or in a *char-var* (character variable). See *System/23 Communications Guide*.

Example

```
10 OPEN #1:"NAME=ITEMS",INTERNAL,INPUT,RELATIVE
20 LET I=25
30 READ #1,USING 40, REC=I:I$,D$,A,B,C NOREC QUIT
40 FORM C 5,C 10,N 6,N 9.2,N 17.2
   •
   •
90 QUIT: CLOSE #1:
```

Record number 25 of the file ITEMS is read in statement 30.

An unformatted READ into an array that is too large will cause an error. The following example will READ variable size unformatted records containing numeric data.

```
 10 OPTION BASE 1
 20 DIM INARRAY (50)
 •
 •
 80 READ #1,USING 90:L$,H$
 90 FORM C 1,C 1
100 LET COUNT=ORD(L$)+256*ORD(H$)
110 MAT INARRAY=INARRAY(COUNT)
120 REREAD #1:MAT INARRAY
```

The following is a KEYED example:

```
 10 OPEN #30:"NAME=KMAST,KFNAME=KINDX",
             INTERNAL,INPUT,KEYED
 20 A$="NEAT'
 30 READ #30,USING 40,KEY=A$:B$,F$,
         X NOKEY DONE
 40 FORM C 4,X 5,C 16,X 2,N 3
     •
     •
     •
100 DONE: CLOSE #30:
```

The first record with a key field equal to NEAT is read in statement 30.

READ statement (with file reference) (continued)

Programming considerations

- No positional specifications
  - If the file was opened with the KEYED parameter and if the KEY/SEARCH parameter is not entered, the next sequential record in the file is accessed in ascending key sequence. If the file was opened with the RELATIVE parameter and the REC parameter is not specified, then the next sequential record is accessed.

- Key length
  - The length of the KEY parameter must be equal to the record key field.
  - The length of the SEARCH parameter must be less than or equal to the length of the key.

- Skipping records
  - The data-item parameter can be omitted on READ to allow for error checking. There will be no transfer of data to variables, but a record will be read.

- Unformatted READ
  - To correctly interpret an unformatted record, the data types of the READ input list must match, element by element, with the data types in the WRITE statement that created the record. If the input list contains an arithmetic data item and the field length is not 9, a CONV error occurs. No other errors are detected. Character strings of length 9 can be interpreted as numeric values, and numeric values can be interpreted as character strings of length 9.

- Errors
  - If REC= is specified and the record is deleted or is greater than the largest record number, a NOREC error will occur.
  - If the KEY and SEARCH parameters are specified for a file which has not been opened as an index file, an error will occur.

Record I/O files

see "Internal I/O files"

REC(N)

REC returns the record number, in file N, of the last record processed. A -1 is returned if the file is not open or if it is a display or keyed file. Zero is returned if no records have been processed.

Redimensioning arrays

Numeric and character arrays can be redimensioned according to the following rules:

- Both one-dimensional and two-dimensional arrays can be redimensioned.
- The total number of elements in any array after redimensioning must not exceed the number originally specified when the array was dimensioned.
- The number of dimensions can be changed. A one-dimensional array can become a two-dimensional array and a two-dimensional array can become a one-dimensional array.
- The maximum value for a dimension is 9999 or is determined by the available storage.
- An array can be redimensioned in a MAT assignment (simple) statement or by using the ZER or CON functions (see "MAT assignment (simple)" and "ZER and CON").
- The new dimensions for the array can be specified with either a constant or an expression. The expression cannot contain subscripts.
- Redimensioning cannot occur on input or output data-item lists.
- The array is allocated storage when it is first referenced. After redimensioning, the unused storage of the array can be reused.
- The maximum length of each element in a character array cannot be changed.

Example

```
10 OPTION BASE 1
20 DIM BIG(50,50)
•
•
•
100 BIG(37,42)=12345.6 !SPACE FOR ARRAY "BIG"
•
•
•
300 MAT BIG=ZER(1,1) !MOST OF SPACE FREED UP
```

The preceding example shows how an array can be redimensioned in line 300. Line 300 takes the 50 X 50 array and makes it a 1 X 1. The data in BIG (37, 42) is lost.

Referencing, substrings

see "Substring referencing"

Relational expressions

see "IF, THEN, ELSE statement"

Relative record files

A relative record file is composed of a sequence of equal-size records. A record may be empty or may contain data. Each record has a number associated with it (a relative record number), starting with one up to the number of records contained within the file. The relative record number is an index by which a record may be accessed for input or output. This number is not in the record. Access, using a relative record number, is made independent of the contents of any other record. Access to a relative record file may be either on a random basis or on a sequential basis. Relative record files can be accessed by relative record number and then accessed sequentially.

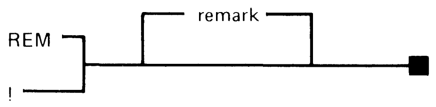
Record oriented statements accessing keyed files may specify either a KEY clause or a SEARCH clause. Record oriented statements accessing relative record files may specify a REC clause. A REC clause is mutually exclusive with either a KEY or a SEARCH clause. WRITE to a relative record file must contain a REC= clause referencing a deleted record only. The location following the last record in the file is considered a deleted record. The maximum number of records is 16,777,215.

A relative record file is accessed by:

- CLOSE
- DELETE
- OPEN (Internal)
- READ
- REREAD
- RESTORE
- REWRITE
- WRITE

REM statement

The REM statement is used to insert remarks or comments in a BASIC program.



remark is one or more characters. This is an optional entry.

The REM statement is descriptive and not executed. It appears in the program listing, but has no effect on program execution.

Example

```
10 REM THIS PROGRAM DETERMINES THE COST PER UNIT
```

or:

```
10 ! THIS PROGRAM DETERMINES THE COST PER UNIT
```

Remarks

Remarks may be added to a program by using the REM statement or an exclamation point, or to an existing statement by using an ! (exclamation point) followed by a character string. All blanks except one are deleted before and after the exclamation point. Lowercase characters are folded to uppercase unless enclosed in quotes. If blanks are required in the remark field, they must be preceded by a non-blank character (see example). Remarks are not permitted on DATA statements and should not be used on the DEL command.

Example

```
10 FOR MONTH=1 TO 12 !BEGIN LOOP
20 NEXT MONTH!"                  end of loop"
30 A=B !*     SAVE B
```

RENAME command

The RENAME command is used to rename a file on diskette.

```
RENAME—— old-file-spec , new-file-name ——■
```

The syntax of the RENAME command is as shown above, where:

old-file-spec is the current file specification. For more information, see "File specification parameter."

new-file-name is the new name to be assigned to the file. This name must not already exist on the volume.

The RENAME command is rejected if *control reserve* is set for the file, if the file is in *open* status, or if the diskette is volume access protected. See "DIR command" and "File sharing."

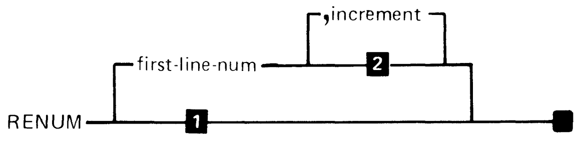
Example

RENAME OLD.FILE, NEW.FILE

This changes the name of the file OLD.FILE, to NEW.FILE.

RENUM command

The RENUM command generates *new* line numbers for all BASIC program statements or data in the work area. Renumbering begins with line number 10 and the increment is 10, unless otherwise specified. All references to line numbers such as in GOTO, IF, PRINT USING, GOSUB are changed to the new numbers.



1	RENUM 10,10
2	Increment is 10

The syntax of the RENUM command is as shown above, where:

first-line-num is the new beginning line number of the renumbered work area. If there is no first-line-num specified, a beginning number of 10 is the default value.

increment is the number specifying the increment for the succeeding statement numbers. If there is no increment number specified, an increment of 10 is the default value. If a first-line-num is not specified, increment cannot be specified.

Example

This example shows the execution of a RENUM command:

```
RENUM 20, 15
```

Before	After
10 INPUT A,B	20 INPUT A,B
11 Q=INT (A/B)	35 Q=INT (A/B)
19 IF Q=-1 THEN STOP	50 IF Q= -1 THEN STOP
20 IF Q=0 THEN 30	65 IF Q=0 THEN 95
25 GOTO 10	80 GOTO 20
30 PRINT Q	95 PRINT Q
35 GOTO 10	110 GOTO 20
40 STOP	125 STOP

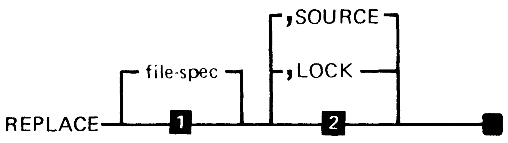
Programming considerations

- Interrupted program
  - The RENUM command is not valid during interrupted program execution.
- Permanent renumbering
  - After using RENUM, use the REPLACE command to update the file stored on diskette because RENUM only changes the file in the work area.

For related information, see "MERGE command."

REPLACE command

The REPLACE command is used to save the contents of the work area to an existing file. This command is similar to SAVE but applies only to files existing on a diskette, where no name change is intended.



1 Use the file last saved or loaded.
2 Internal format

The syntax of the REPLACE command is as shown above, where:

file-spec is the file specification. For more information, see "File specification parameter." If the file does not already exist, an error will occur.

SOURCE indicates that the program is to be saved in source format. If SOURCE is not specified, the program is saved in BASIC format. In either case, the file type must conform to the present type stored on diskette. SOURCE files are type 05, BASIC program files are type 09.

LOCK indicates that the program is to be locked. A locked program may not be listed, saved, or replaced in source format. Once the program is locked, it cannot be unlocked. A copy of the unlocked program should be kept by the programmer.

Programming considerations

- Diskette full
  - If there is not enough space on the diskette to save the entire file, an error occurs. In this case, the file should be saved on another diskette.

- No file specification
  - SOURCE must be preceded by a comma if no file specification is specified; otherwise, SOURCE will be assumed for the file name.

- Cmd/Attn
  - Cmd/Attn will not interrupt during a REPLACE.

- Interrupted program
  - The REPLACE command cannot be issued if the program is interrupted; enter GO END before issuing REPLACE.

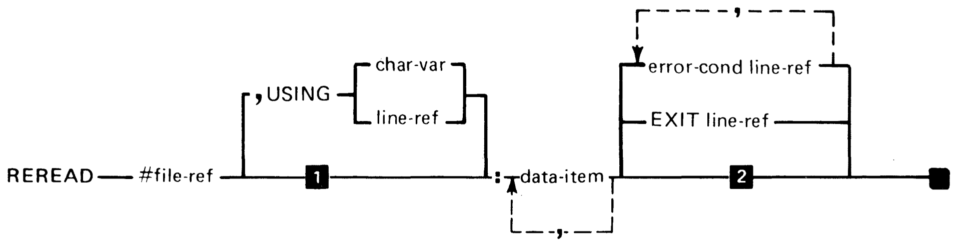
- Compressing the work area
  - No additional storage becomes available as a result of editing. Additional storage will be available if the program is SAVEd or REPLACEd in source format, then LOADed.

Replacing a statement

see "Editing a program"

REREAD statement

The REREAD statement assigns values from the most recent record READ or REREAD from the file.



1 Unformatted REREAD
2 Interrupt on error unless ON is active

The syntax for the REREAD statement is as shown above, where:

file-ref is a numeric expression. See "File reference parameter."

USING specifies a *line-ref* (line reference) of a FORM statement or a *char-var* (character variable) containing a FORM statement. *line-ref* can be a line number or label. The FORM statement is used to indicate the representation and location of values to be assigned to variables in the input list that will be read. If no USING is specified, the record is read unformatted. See "Internal I/O file formatting."

data-item specifies the names of variables to be read into from the file. Data items can be variables, array elements, or entire arrays (preceded by MAT). The data items must be separated by a comma. The first data item must be preceded by a colon.

error-cond line-ref specifies the line number or label that the program should transfer to if one of the error conditions occurs. The following error conditions may be included in any order:

- CONV—conversion error
- IOERR—input/output error
- NOKEY—key not found; invalid key reference
- NOREC—no record found; invalid record reference
- SOFLOW—string overflow

See "EXIT statement" for more information on these error conditions.

EXIT line-ref specifies the line number or label of an EXIT statement that the system should reference if an error occurs.

Example

```
 5 DIM D$*20
10 OPEN #1:"NAME=ITEMS",INTERNAL,INPUT,RELATIVE
20 FOR I=1 TO 100
30 READ #1,USING 40,REC=I:I$,D$
40 FORM C 5,V 20,N 6,N 9.2,N 17.2
50 IF D$="BOLTS" "BOLTS" THEN GOTO 80
60 REREAD #1,USING 40:I$,D$,Q,P,P1
70 NEXT I
80 ! CONTINUE OPERATION
```

Reserved words

The following words are reserved for System/23 BASIC and cannot be used as the name of user-defined variables or statement labels.

ABS	EXP	NEWPAGE	RETRY
AIDX	FIELDS	NEXT	RETURN
AND	FILE	NOKEY	REWRITE
ATN	FILES	NONE	RLN
ATTN	FN	NOREC	RND
BELL	FNEND		
CEIL	FN---	OFLOW	ROUND
CHAIN	FOR	ON	SEQUENTIAL
CLOSE	FORM	OPEN	SGN
CMDKEY	FREESP	OPTION	SHIFT
CNT	GO	OR	SIN
CODE	GOSUB	ORD	SOFLOW
CON	GOTO	OUTIN	SQR
CONTINUE	IF	OUTPUT	SRCH
CONV	IGNORE	PAUSE	STEP
COS	INTERNAL	PI	STOP
DATA	INPUT		SUB
DATE	INT	PAGEOFLOW	SYSTEM
DEF	IOERR	POS	TAB
DELETE	KEY	PRINT	TAN
DIDX	KEYED		THEN
DIM	KLN	PROCIN	TIME
DISPLAY	KPS	RANDOMIZE	TO
DISPLY	LEN	RD	TRACE
DUPREC	LET	READ	UDIM
ELSE	LINE	REC	UFLOW
END	LINPUT	RELATIVE	USE
EOF	LOG	REM	USING
ERR	MAT	REREAD	VAL
ERROR	MAX		WRITE
EXIT	MIN	RESTORE	ZDIV
			ZER

The following words cannot be used as the names of user-defined character variables.

CHR$	KSTAT$	RPAD$	STR$
DATE$	LPAD$	RPT$	TIME$
FILE$	LTRM$	RTRM$	WSID$
HEX$	PIC$	SREP$	

RESTORE statement (with no file reference)

This RESTORE statement causes subsequent READ statements to assign values beginning with the first item in the first DATA statement (see "DATA statement").

```
RESTORE ────────■
```

The syntax of the RESTORE statement is as shown above.

The RESTORE statement returns the internal data table pointer from its current position to the beginning of the table.

A RESTORE statement is ignored in a program that contains no DATA statements.

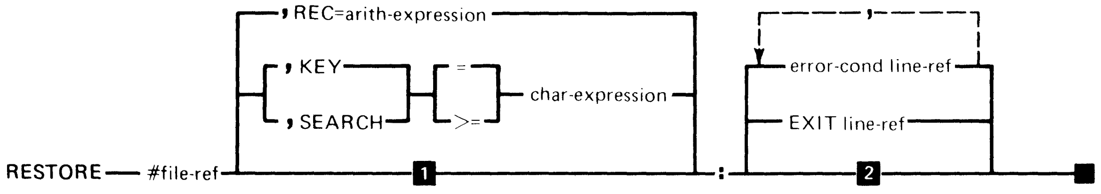
Example

```
10 DATA 1,2
20 READ A,B
30 RESTORE
40 READ C,D
```

In the above example, after the statements are executed, the variables A and C will each have a value of 1 and variables B and D will each have a value of 2.

RESTORE statement (with file reference)

This RESTORE statement is used to reposition a file.



1 Go to the beginning of the file (if opened for output, DROP the file)
2 Interrupt on error unless ON is active

The syntax of the RESTORE statement is as shown above, where:

file-ref is a numeric expression. See "File reference parameter."

When a RESTORE statement (without a parameter) is executed, the specified display or internal I/O file is repositioned so that subsequent references to the file will refer to the beginning of the file.

REC=arith-expression for relative access, specifies the number of the record to which the file will be reset. The record specified by the arithmetic expression will be the next record in the file to be accessed by a READ without a REC clause.

KEY for keyed access, specifies the key field used to access the record in the file. KEY indicates key-indexed access of the file, which must have been opened as a keyed file.

RESTORE statement (with file reference) (continued)

char-expression parameter contains the actual record key to be compared to those records in the file. The character expression must be the same length as the key field.

SEARCH for keyed access specifies the key field used to access the record in the file. SEARCH indicates key-indexed access of the file.

char-expression can be less than or equal to the length of the actual key field. If the char-expression is shorter than the key field, the search of the index will consider only that part of the key field equal to the length of the character expression.

= specifies that the KEY/SEARCH argument must make an exact match to the record key.

>= specifies that if an equal compare is not made, the next record in key sequence following the provided key is used.

error-cond line-ref specifies the line number or label that the program should transfer to for one of the error conditions. The following error conditions may be included in any order:

- IOERR—input/output error
- NOKEY—invalid key reference
- NOREC—invalid record reference

See "EXIT statement" for more information on these error conditions.

EXIT specifies the line number or label of an EXIT statement that the system should reference if an error occurs.

Programming considerations

- Adding data
  - To position to the end of data, close the file, then reopen the file for output.
- RESTORE #0
  - RESTORE with a file reference of #0 is ignored.
- Dropping data
  - A RESTORE statement specifying no parameters positions the file at the beginning of data. For the following specific cases, previously valid data becomes inaccessible (same action as DROP command):
    1. A display file opened for output, NOSHR, sequential access.
    2. An internal file opened for output, NOSHR, sequential access.

    An error occurs if a RESTORE statement is executed for an internal file opened for output with relative or keyed access.

RETRY statement

The RETRY statement transfers control to the statement causing the most recent error not suppressed by an ON condition IGNORE. See "ON statement".

```
RETRY────────■
```

RETRY is useful following an ON GOTO transfer or following an I/O exit. Any event that can cause an ON GOTO transfer or an I/O exit will set the line to which retry will transfer control.

If an ON event is specified to be IGNORED, the return statement specification used by RETRY is not changed.

Example

```
100 ON ZDIV GOTO FIX
 •
 •
 •
300 INPUT C
310 Z = 10/C
 •
 •
 •
400 FIX:   C= 1 !0 ENTERED FOR C
410 RETRY ! REEXECUTE LINE 310
```

Programming considerations

- RETRY without error
  - If no error has occurred since RUN, execution of RETRY will cause an error and will interrupt execution.

- RETRY after INQ
  - Execution of RETRY following INQ causes the same line to be executed again.

- Multiple errors
  - If a second ON GOTO or I/O exit occurs before RETRY is executed,the first occurrence is lost. Avoid operations that can cause such occurrences or use ON . . . . IGNORE.

For a description of special handling of ON events and I/O exits within a defined function, see "DEF,FNEND statement."

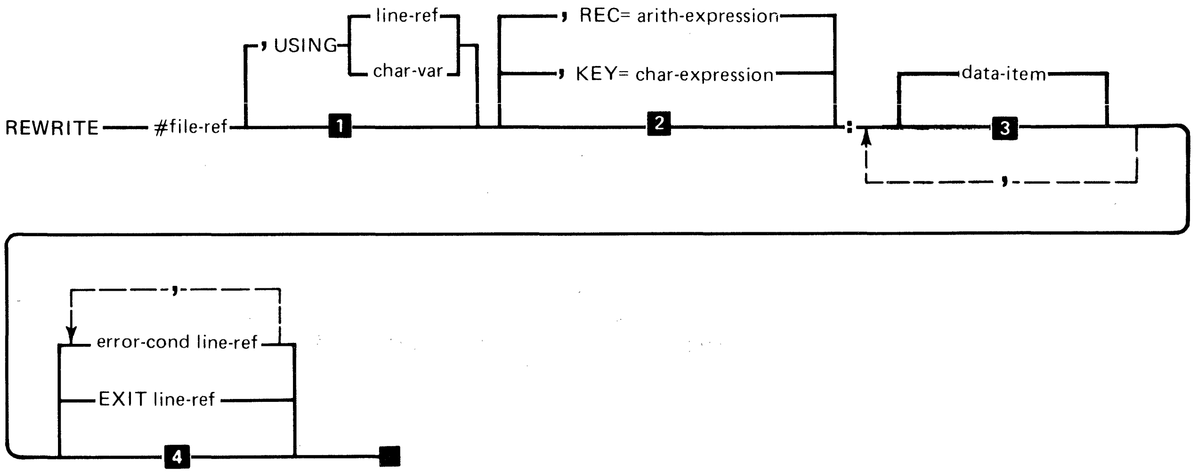
RETURN statement

The RETURN statement transfers program control to the first executable statement following the most recently executed GOSUB statement (see "GOSUB statement").

```
RETURN────────■
```

REWRITE statement

The REWRITE statement is used to replace an existing record in a file.



- **1** Unformatted write
- **2** Rewrite the last record READ/REREAD
- **3** REWRITE record with no data
- **4** Interrupt on errors unless ON is active

The syntax of the REWRITE statement is as shown above, where:

file-ref is a numeric expression. See "File reference parameter."

USING specifies a *line-ref* (line reference) of a FORM statement or a *char-var* (character variable) containing a FORM statement. *Line-ref* can be a line number or label. The FORM statement is used to indicate the type, length, and locations of the variable values (data items).

REC=arith-expression specifies the record having a relative record number equal to an arithmetic expression.

KEY=char-expression specifies the key field used to access the record in the file.

data-item specifies the names of variables or expressions that contain the values to be written to the file. Data items can include variables, array elements, entire arrays (preceded by MAT) or numeric or character expressions. The data items must be separated by a comma. The first data item must be preceded by a colon.

error-cond line-ref specifies the line number or label that the program should transfer to if one of the error conditions occurs. The following error conditions may be included in any order:

- CONV—conversion error
- EOF—end of file; insufficient file space for data
- IOERR—input/output error
- NOKEY—key not found; invalid key reference
- NOREC—no record found; invalid record reference
- SOFLOW—string overflow

See "EXIT statement" for more information on these error conditions.

EXIT line-ref specifies the line number or label of an EXIT statement that the program should transfer if an error occurs.

For more information, see Appendix B.

REWRITE statement (continued)

Example

```
10 OPEN #3:"NAME=FILEB",INTERNAL,OUTIN
20 DIM A$(6)*3
30 READ #3: MAT A$
40 A$(3)= "ABC"
50 A$(6)= "XYZ"
60 REWRITE #3: MAT A$
```

Programming considerations

- OPEN OUTIN
  - OUTIN must be specified in the OPEN INTERNAL statement.
- Preceding statements
  - REWRITE must be preceded by a successful READ or REREAD to the same file reference if no KEY or REC parameter is specified. If KEY or REC is specified, the record is read before it is updated and rewritten.
- No data
  - If the I/O list is omitted there will be no transfer of data from variables. A record will be written.
- Key field
  - A REWRITE to a file opened for keyed processing cannot alter the key field.
  - A REWRITE may modify any field other than the one used for the associated key specified by OPEN. This includes fields used for other keys. If the field is modified, the associated key file must be regenerated by the INDEX Customer Support Function before it is used again. If this is not done unpredictable modifications to the Master file may result if there is

  a subsequent WRITE/REWRITE/DELETE operation that uses that key field.
  - There is no check made to verify that the Master file record obtained (using the index file) contains the key characters indicated by the KEY= specification.

- Communications
  - REWRITE is not applicable to Communications.

- Multiple REWRITEs
  - When a file is opened INTERNAL, OUTIN, KEYED, or RELATIVE, a REWRITE statement without a record specifier (KEY= or REC=) can be used to update portions of a record which was just accessed by READ or REREAD. The record may not be processed by a second chronologically sequential REWRITE without another intervening READ (KEY= or REC=). See "I/O table 7" and "I/O table 8".

    If the record cannot be completely updated in one REWRITE because of a long FORM specification or data list, a second REWRITE may be required. This requirement can have the following effects:

- If the file is in SHR (shared) mode, the other program may access the updated record between the two (or more) REWRITE statements. This provides a copy of the record which is not valid to the READ statement in the other computer.

- If the record is one of a group with duplicate keys, the program may require considerable time to reaccess the record. The reason for this is that it must search through all the preceding duplicate keys.

REWRITE statement (continued)

The above mentioned effects can be avoided by creating a temporary file with one record. This record should be the same size as the record in the data file. The following code will then update the record without excessive search time or loss of data integrety:

Assume a record length of 2000 bytes.

```
  5 WORK=5
 10 OPEN #WORK:"NAME=WORKFILE/VOID,SIZE=2001,
    RECL=2000",INTERNAL,OUTIN,SEQUENTIAL
 20 DIM A$(8)*250   ! USE THE MINIMUM NUMBER OF
                      ELEMENTS MAXIMUM LENGTH
 •
 •
 •
100 MAT A$=A$(8)
110 READ #DATAFILE,USING COPYFORM:MAT A$
120 COPYFORM: FORM C 250
130 RESTORE #WORK:
140 READ #WORK:
150 REWRITE #WORK,USING COPYFORM:MAT A$
160 MAT A$=A$(1)
 •
 • PERFORM MULTIPLE REWRITES TO WORK FILE
 •
300 MAT A$=A$(8)       !  REDIMENSION A$
310 RESTORE #WORK:
320 READ #WORK,USING COPYFORM:MAT A$
330 REWRITE #DATAFILE,USING COPYFORM:MAT A$
340 MAT A$=A$(1)    !  RELEASE STORAGE
 •
 •
 •
```

See "Program 5-Sample" in Appendix A.

RLN(N)

RLN returns the record length for internal file N. If file N is not open, a -1 is returned.

RND(X)

RND returns a random number in the range of 0 to 1. If X or the RANDOMIZE statement is specified, the random number generator is reset. Each random number is computed from the previous one according to a fixed algorithm. When X is specified, the number generated is the number that would normally follow X. The value specified for X must be greater than 0 and less than 1.

If X is not specified and RANDOMIZE is not executed, 2.1E9 unique numbers will be generated before the sequence repeats. Run starts the random numbers at the same point each time.

See "Program 2-Sample" in Appendix A.

ROUND(X,M)

ROUND returns the value of X rounded to M decimal digits to the right of the decimal point. If M is negative, X is rounded to the left of the decimal point (M trailing zeros following the number). For example:

```
10 X=15.735
20 R=ROUND (X,2)
```

R contains 15.74

```
10 X=273
20 R=ROUND(X,-2)
```

R contains 300

RPAD$(A$,X)

RPAD returns a string of characters of length X or greater by placing the required number of blanks to the right of A$. If X is less than the length of A$, then A$ is returned unchanged. For example:

```
10 A$="ABCD"
20 B$=RPAD$(A$,5)
```

B$ contains "ABCDƀ"

```
10 A$="ABCD"
20 B$=RPAD$(A$,2)
```

B$ contains "ABCD"

Note: An error is generated if X is not within the 0 to 255 range.

RPT$ (A$,M)

RPT$ returns A$ repeated M times. For example:

```
ABC$=RPT$("*",3)
```

ABC$ Contains "***"

Note: When the result of RPT$ exceeds 255 characters, the result will vary based upon the function being performed.

RTRM$(A$)

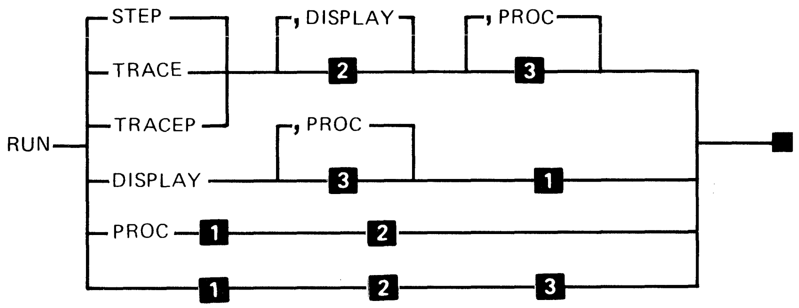
RTRM$ returns A$ with all trailing blanks removed.

```
10 A$=" AB CD "
20 B$=RTRM$(A$)
```

B$ contains " AB CD"

RUN command

The RUN command starts execution of a BASIC program at the lowest numbered executable statement. The program must reside in the work area, and the work area must be defined as containing a BASIC program.



$\boxed{1}$ Normal execution mode
$\boxed{2}$ Direct printed output to printer
$\boxed{3}$ INPUT, LINPUT #0 from keyboard

If DISPLAY or PROC parameter follows the RUN command, no comma is necessary.

The syntax of the RUN command is as shown, above where:

STEP specifies that the program stops before each statement is executed. The word STEP and the line number of the next statement to be executed are displayed. To execute the next statement, a GO command must be entered and press Enter. Execution will not stop inside user-defined functions.

TRACE specifies that the line number of each statement be displayed when the statement is executed.

TRACEP specifies that the line number of each statement be printed on the printer when the statement is executed. TRACEP should be used if tracing to the display screen would overwrite valid information. The tracing information is accumulated until a line is full or until the printer is closed (for example, program terminates).

DISPLAY specifies that all PRINT #255 statements directed to the printer should instead be directed to the screen.

PROC specifies that data for INPUT and LINPUT statements should come from a procedure file rather than from the keyboard. This does not apply to INPUT FIELDS (see "Full screen processing"). PROC is only valid on a RUN command issued from a procedure file.

Example

```
LOAD PAYROLL/LEDGER
RUN
```

A program named PAYROLL is loaded from a diskette with VOLID LEDGER. The program is then executed.

Programming considerations

- Variable initialization
  - Each time the RUN command is issued it initializes all arithmetic variables and arrays to zeros, and character variables and arrays to null.

- Resuming normal processing
  - If a RUN STEP is in process and normal processing is required, GO RUN can be issued.

RUN command (continued)

- Data work area
  - The RUN command will not be accepted by the system if the work area contains data rather than a program.

- Error conditions

  The following errors will be detected before the first statement is executed:
  - An END statement appears and it is not the last statement.
  - An undefined line number is found.
  - FOR/NEXT loops are improperly nested.
  - A previous RUN was interrupted. In this case enter GO END then RUN (see "Split screen").
  - An array or character variable is DIMed more than once.

- TRACEP and DISPLAY
  - If both TRACEP and DISPLAY are present, the trace information will be directed to the screen.

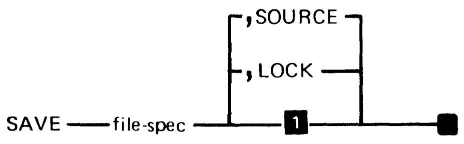
- TRACE
  - RUN TRACE(P) will trace the whole program. Use the TRACE statement to trace small portions of the program; see "TRACE statement."

Sample procedure or Sample program

see Appendix A

SAVE command

The SAVE command stores the contents of the work area in a specified file. SAVE is used to store a new program or data file for the first time, or an existing program or data file under a new name.



1 Save internal (file type 09)

The syntax of the SAVE command is as shown above, where:

file-spec is the file specification. For more information see "File specification parameter."

Since SAVE is used to store a program or data file not already existing under the name chosen, the file name must be qualified by a volume ID or by a drive number.

SOURCE indicates that the program is to be saved in source format as file type 05. If SOURCE is not specified, a program is saved in BASIC format as file type 09, data is saved as file type 05.

LOCK indicates that the program is to be locked. A locked program may not be listed, saved, or replaced in source format.

SAVE command (continued)

Examples

```
SAVE MYPROG/MYVOL
```

or

```
SAVE MYPROG.SRC//1,SOURCE
```

Programming considerations

- Locked programs
  - A locked program cannot be unlocked. The programmer should keep an unlocked version.
- Existing files
  - To save an existing program on diskette, use REPLACE.
- Interrupted programs
  - SAVE cannot be issued if a program is in an interrupted state (from an error or Cmd/Attn), first enter GO END.
- Cmd/Attn
  - Cmd/Attn will not interrupt during a SAVE.
- Diskette full
  - If there is not enough space on the diskette to save the entire file, an error will occur. In this case, the file should be saved on another diskette.
- LOAD and SAVE
  - Program files (type 09) load and save faster than source files (type 05).

- Compressing the work area
  - No additional storage becomes available as a result of editing. The additional storage will be made available when the program is SAVEd or REPLACEd in SOURCE format, then LOADed.

Scalar multiplication (MAT assignment)

see "MAT assignment (scalar multiplication)"

Search

see
"SRCH(array,X[,row]) or SRCH(array$,X$[,row])"
"Diskette file searches"

SGN(X)

SGN returns the sign of X.

SGN(-2) is -1 (representing a negative number)

SGN(+10) is +1 (representing a positive number)

SGN(0) is 0

Sharing

see "Device sharing"
"File sharing"
"OPEN statement"

SHIFT(X)

SHIFT returns a value to indicate the machine type (Katakana or non-Katakana). The X parameter, which is optional, establishes a new shift mode.

Machine type	**Value returned**	**Value of X**
Non-Katakana	0	0 = lowercase 1 = uppercase
Katakana	1	0 = alphanumeric 1 = Katakana

The following PRINT statement will display the machine type:

```
10 PRINT SHIFT
```

The following LET statement will set a non-Katakana machine to uppercase shift mode:

```
20 LET A=SHIFT(1)
```

Sign of a number

see "SGN(X)"
"Arithmetic data"

Significance

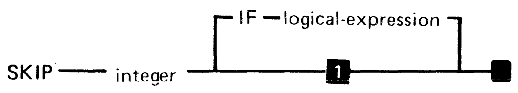
see "Arithmetic data"

SIN(X)

SIN returns the sine of X. X is in radians and must be less than 1E10. Specify a value for X greater than -2*P1 or less than 2*P1 for best accuracy.

SKIP command

The SKIP command is used to skip records within a procedure file.



1 Skip unconditionally

The syntax of the SKIP command is as shown, where:

integer indicates the number of records within a procedure file to be skipped.

logical-expression transfers procedure control according to the result of the logical expression (see "IF, THEN, ELSE statement"). Only CODE and ERR can be tested in the logical expression.

When the IF clause is specified on the SKIP command, the logical expression is evaluated. If the evaluation results in a true condition, the specified number of procedure file records are skipped. If the evaluation results in a false condition, no procedure file records are skipped.

The SKIP command without the IF clause causes the specified number of records to be skipped unconditionally.

Example

```
00010:LOAD FIRST
00020:RUN
00030:SKIP 3 IF CODE > 0
00040:LOAD SECOND
00050:RUN
00060:SKIP 3
00070:ALERT INSERT TRANSACTION DISKETTE
00080:LOAD THIRD
00090:RUN
```

In this example, the program in file FIRST is loaded and executed. If the program causes the value of the CODE variable to be set to positive, the SKIP 3 IF CODE > 0 causes the next 3 records in the procedure file to be skipped and the ALERT command to be processed. The program in file THIRD is then executed. IF the value of the CODE variable from program FIRST is zero or less, the program in file SECOND is loaded and executed, then SKIP 3 unconditionally skips the last 3 commands.

The line numbers and colons are not part of the data on the procedure file. They are added and used by the editing commands.

Skip Lines

see "FORM statement" (SKIP specification)

SORT command

The SORT command alters the order of the records in a file. SORT can be specified from a procedure file or entered from the keyboard.

```
SORT— file-spec ———■
```

The syntax of the SORT command is as shown above where:

file-spec is the file specification of a previously generated Sort control file,which consists of a file name followed by an optional volume identification and device address (see "File specification parameter").

Information for the sort is always taken from the control file specified by the file-spec. See *Customer Support Functions,* Volume II for more information about SORT.

The SORT command is used in conjunction with the Customer Support Function diskette.

Spaces

see "Blanks"

Special character set

see "Character set"

Split screen

When a running BASIC program is interrupted by an untrapped error followed by an ERROR RESET, Cmd/Attn, or PAUSE statement in the program, the screen goes into *split screen* mode.

Lines 19 to 23 are temporarily replaced with a four-line blank area topped by a row of asterisks. This allows the entry of commands and desk calculator operations without disturbing the original screen.

If you enter any command which restarts or terminates the program, the "split screen" is removed and replaced with the former display. Use the GO command to restart and GO END or CLEAR to terminate (see "GO command").

SQR(X)

SQR returns the square root of X. If X is less than zero, an error occurs.

Square roots

see "SQR(X)"

SRCH (array,X[,row]) or SRCH (array$,X$[,row])

SRCH searches for the value of X. The result is a number that indicates in which row the argument X was found. Row, which is optional, is used to select the starting row within the vector. The default row is 0 (Base 0) or 1 (Base 1). If the argument is not found, -1 is returned. If the array has never had anything assigned to it, a -1 is returned.

Note: An error will be generated if row is not within the range 0 to 255.

SREP$(A$,M,B$,C$)

SREP$ returns a string that represents the replacement of B$ with C$ in string A$, starting at position M.

```
10 A$="ABCDEFGHIJ"
20 B$="DE"
30 C$="123"
40 D$="SREP$(A$,4,B$,C$)
```

D$ contains "ABC123FGHIJ"

Note: An error will occur if the string length exceeds 255.

Standard format

see "Integer format"

Statement length

see "BASIC statements"

Statement numbers

see "Line numbers"

Statements

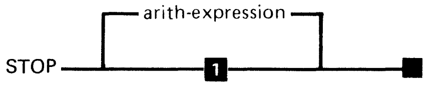
see "BASIC statements"

Status line

see
- "Character set"
- "Device sharing"
- "DISPLAY"
- "Status line" in the *Operator Reference System/23 Messages*

STOP statement

The STOP statement stops the program and closes all files.



■1 CODE is 0

The syntax of the STOP statement is as shown above, where:

arith-expression is an expression that is rounded to an integer and is used to set the CODE variable. It is in the range of 0 to 9999. If the parameter is not specified, the default is zero.

Unlike the END statement, the STOP statement can appear anywhere in a BASIC program.

Example

With arith-expression:

```
110 CODEVAL = 139
120 STOP CODEVAL
```

In this example, the STOP statement sets the value returned by CODE to 139 and stops the program.

Without arith-expression:

```
110 STOP
```

In this example, the STOP statement sets the value returned by CODE to 0 (the default value) and stops the program.

Storage use

The following formulas are used to estimate the amount of System/23 internal storage used by unedited programs. The total storage available is indicated by the HELP STATUS command immediately following CLEAR.

For programs, calculate the following items and add 27 bytes for overhead:

Item	**Bytes**	**Notes**
Statement	7	
Function reference	2	4
Keyword	1.5	1
Label	1.5	1 4
System function	1.5	1
Variable/array reference	1.5	1 4
Line number reference	4	
Character literal	2	2
Numeric literal	4 or 10	5
Expression	1	3
FORM field specifier	2	
PIC specification	2	2
Subscripts	4 or 6	6
Substring	6	6
Operators	1	7
Punctuation	1	8
Asterisk	2	9
FOR, NEXT	4 or 25	10
CHAIN, USE, LIST	2	11

1 Frequently used functions, variables, and first 63 user defined names are 1 byte. Others are 2 bytes.
2 Plus the number of characters.
3 See "Arithmetic expression", "Character expression".
4 Name length plus 5 for first time reference
5 Literals used in DIM and FORM use 4 bytes.
6 4 bytes for ( ) format, 6 bytes for (,) format, 6 bytes for (:) format. Byte totals only included punctuation characters and end of expression overhead.
7 Applies to logical operators, arithmetic operators, concatenation character, and =.
8 Punctuation characters are # : ; ( ) and ,
9 Used in DIM and FIRM
10 FOR is 4 bytes, NEXT is 25 bytes
11 The variable list and any remark that follows, is treated as a single character literal string. Add the number of characters.

When the program is run, both user-defined objects and system objects use storage as follows:

Item	Bytes
Character variable	7+ current number of characters 1
Character array	13+ (1+DIM length) *number of elements 1
Numeric variable	15 1
Numeric array	I3+ (9*number of elements) 1
File controls	132 per file 2
Procedure	650/132 per procedure 3

1 Allocated at first reference, released at CLEAR/RUN
2 Allocated at OPEN, released at CLOSE
3 Allocated at PROC/SUBPROC, released at EOF

Storage use (continued)

As the program is run, temporary results, work areas, and I/O buffers are allocated as needed and automatically released. No single item can exceed 64K bytes. Editing never decreases the size of a program. To recover space when lines are deleted, SAVE SOURCE, LOAD, and SAVE internal again. Storage can be recovered from arrays by redimensioning to one element. See "Redimensioning arrays". The System/23 will reserve a minimum amount of storage for internal use, so your program cannot entirely fill up storage.

Example

```
100 LET WORK5$(1:2)=RUNDAT$(5:6)
```

Item	Bytes	Overhead	Comments
LET	1.5		Keyword
WORK5$	1.5	11	Variable/array
(:)	6		Substring
1	10		Numeric literal
2	10		Numeric literal
=		1	Operators
RUNDAT$	1.5	12	Variable/array
(:)	6		Substring
5	10		Numeric literal
6	10		Numeric literal
		7	Statement
		27	Program first line
Totals	57.5	+ 57 =	114.5 bytes

```
200 DEF FNA$(R,K$)=STR$(R+5)&K$
```

Item	Bytes	Overhead	Comments
DEF	1.5		Keyword
FNA$	2	9	Function reference
(	1		Punctuation
R	1.5	6	Variable/array
,	1		Punctuation
K$	1.5	7	Variable/array
)	1		Punctuation
=	1		Operators
STR$	1.5		System function
(	1		Punctuation
R	1.5		Variable/array
+	1		Operators
5	10		Numeric literal
	1		Expression
)	1		Punctuation
&	1		Operators
K$	1.5		Variable/array
	1		Expression
		7	Statement
Totals	31	+ 29 =	60 bytes

STR$

STR$(X)

STR$ returns the string that is the character representation of the value X. The string has the same appearance as though a PRINT X had been issued. There are no leading or trailing blanks. See "PRINT statement".

```
X=12
A$=STR$(X)
```

A$ contains "12"

SUBPROC command

The SUBPROC command is used to initiate the use of a new procedure file without closing the currently active procedure file. A procedure file is a DISPLAY I/O file on diskette that contains BASIC statements, system commands, and/or input data.

```
SUBPROC ——file-spec ————■
```

The syntax of the SUBPROC command is as shown above, where:

file-spec is the file specification, which consists of a file name followed by an optional volume identification and device address (see "File specification parameter").

The SUBPROC command is identical to the PROC command (see "PROC command") with the following exceptions:

- The SUBPROC command may be issued from within a procedure file without causing the procedure file to be closed.
- Termination of a procedure invoked by SUBPROC will cause the procedure file input to revert to the invoking procedure.
- The maximum number of procedure files that can be open at one time is five.

INPUT or LINPUT from a procedure will cause an EOF error when the procedure/subprocedure is exhausted.

Subroutines

see "GOSUB statement"
"RETURN statement"

Subscripted Variables

see "Arrays"

Substring referencing

A substring is a part of a string rather than the entire string. Normally, the entire string is referenced. However, sometimes only a part of a string needs to be referenced. The substring reference is used to extract, replace, or insert characters in a character string.

The substring reference denotes the position within a character string by:

character string (arith-expression:arith-expression)

The first arithmetic expression indicates the beginning position, and the second arithmetic expression indicates the ending position of the substring. The arithmetic expressions cannot be negative and are rounded to integers.

The character string can be an array element. For example:

```
K$ = ABC$(5)(A:B)
```

Substring referencing (continued)

Substring referencing rules are as follows:

Rule 1.	If the beginning position is less than one, it is considered to be one.
Rule 2.	If the beginning position is greater than the length of the character string, the substring addressed follows the last character of the character string. For example: if A$ equals ''ABCD'', the statement A$ (5:7)=''123'' would result in ''ABCD123''.
Rule 3.	If the ending position is greater than the length of the character string, it is assumed to be the length of the character string.
Rule 4.	If the beginning position is greater than the ending position, the substring addressed immediately precedes the beginning position character of the character string. The value of the ending position has no significance. For example if A$ equals ''ABCD'' then the statement A$(3:1)= ''123'' would result in ''AB123CD''.
Rule 5.	In order to assign characters to a string at a specified location, that location must be allocated.

Examples of substring referencing

For the following examples assume that:

A$="ABCDE"

and

B$="WXYZ"

Extraction of characters:

Statement	**Result**
E$=A$(2:3)	E$ equals "BC"
E$=A$(4:4)	E$ equals "D"
E$=A$(0:2)	E$ equals "AB", the zero is considered to be one (see Rule 1)
E$=A$(7:8)	E$ equals " ", a null string (see Rule 2)
E$=A$(4:8)	E$ equals "DE", the eight is considered to be five (see Rule 3)

Substring referencing (continued)

Replacement of characters:

Statement	**Result**
A$(3:4)="12"	A$ equals "AB12E", "CD" is replaced with "12".
A$(3:4)=""	A$ equals "ABE", "CD" is deleted
A$(3:4)=B$(1:2)	A$ equals "ABWXE", "CD" is replaced by "WX"
A$(3:4)=B$(1:4)	A$ equals "ABWXYZE", "CD" is replaced by "WXYZ"

Insertion of characters:

Statement	**Result**
A$(1:0)="123"	A$ equals "123ABCDE", "123" is inserted before the "A" in A$ (see Rule 4)
A$(1:0)=B$(3:4)	A$ equals "YZABCDE", "YZ" is inserted before the "A" in A$ (see Rule 4)
A$(3:2)=B$(1:4)	A$ equals "ABWXYZCDE", "WXYZ" is inserted between the "B" and "C" in A$ (see Rule 4)
A$(7:8)="123"	A$ equals "ABCDE123", 123 is inserted after the "E" in A$ (see Rule 2)

Example using subscripts

```
10 ABC$(4) = "ABC"
20 I = 1
30 J = 2
40 K = 4
50 ABC$ (K)(I:J) = "12"
```

Results in ABC$(4) being "12C"

Example Rule 5

```
10 DIM A$*10
20 A$ (1:4) = "ABCD"
30 A$ (9:10) = "EF"
```

Results in A$ being "ABCDEF".

Notice that character string "EF" was not assigned to location 9 and 10 of A$ as specified. To cause "EF" to be assigned to location 9 and 10 of A$, A$ must first be allocated 10 characters. To achieve that, insert statement 15 (see Rule 5).

```
15 A$ = RPT$("ƀ",10)
```

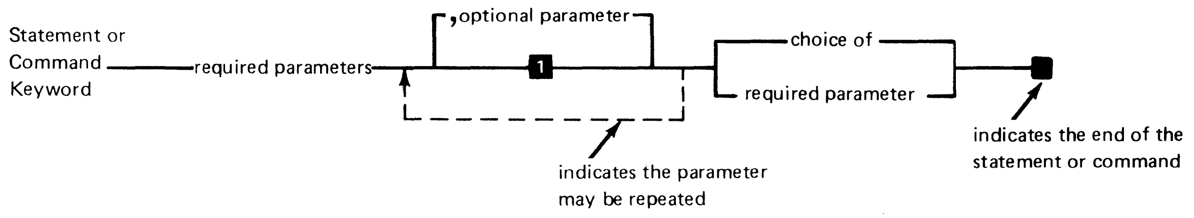
which results in "EF" being assigned to location 9 and 10:

"ABCDƀƀƀƀEF"

Syntax description

When syntax formats are described in this manual, capitalized expressions, lowercase expressions, and special characters (such as a comma, colon, exclamation point, or an asterisk) have special meaning.

Syntax of the BASIC commands and statements is presented in the following format:


Statement or Command Keyword
required parameters
,optional parameter
1
choice of
required parameter
indicates the parameter may be repeated
indicates the end of the statement or command

Where:

Statement or Command keyword is a BASIC statement such as LET or a command such as RUN.

required parameter is an item that must be included such as the line reference in GOTO 100.

optional parameter is an item that may be included if desired such as ELSE in an IF, THEN, ELSE statement.

indicates that the parameter may be repeated means that more than one parameter can be included such as the variables in INPUT A, B, C ...

choice of required parameters means that one of the parameters must be included such as the choice between numeric or character constants in a DATA statement.

indicates the end of the statement or command refers to the block that indicates the end of the syntax.

To read the syntax of a command or statement, read from left to right along the main line. When you reach an optional parameter, you can either include that parameter or continue along the main line. When you reach a choice of required parameters, you must include one of the parameters with your command or statement.

If a parameter is shown in uppercase letters, you must enter it exactly as it appears. You must also enter any special character (such as a comma or colon) that appears in the diagram.

All lines entered in BASIC program entry mode are converted to English uppercase prior to syntax checking.

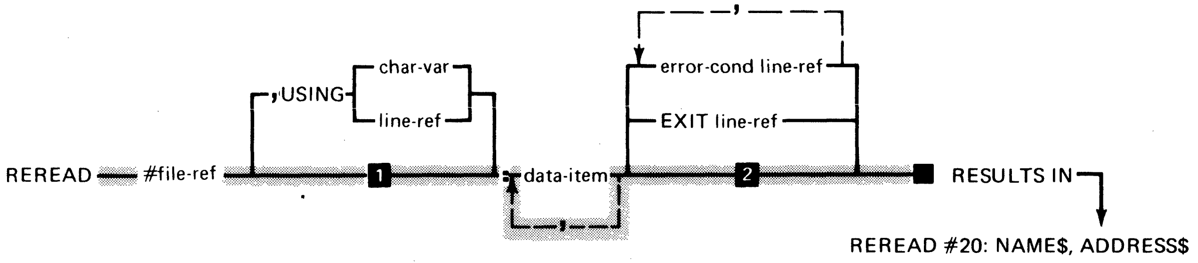
To prevent remarks or character data on DATA statements from being converted to English uppercase, they must be enclosed in quotation marks.

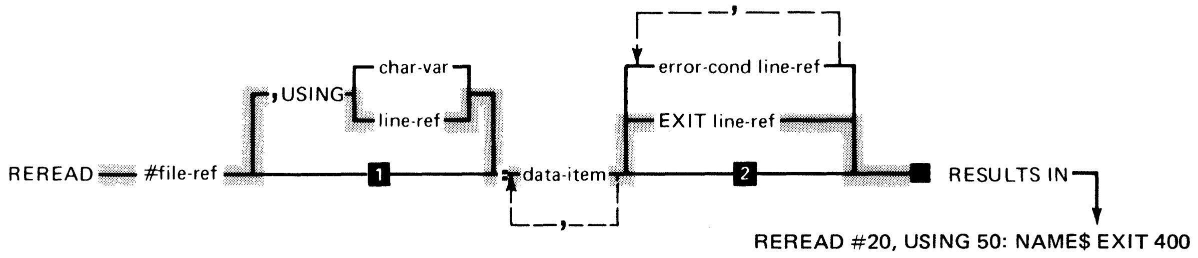
If you do not include an optional parameter, the System/23 provides a default value or action. The defaults are listed in the description of the statement or command. The syntax diagrams include a number (such as $\boxed{1}$) that corresponds to the defaults listed.

In the case of the MERGE, REPLACE, and VOLID commands *only*, you must include a comma to indicate that you have omitted an optional parameter.

Syntax description (continued)

Here are two examples using the REREAD statement:

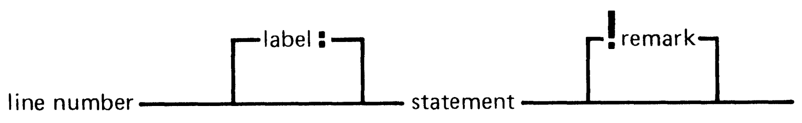




In these examples, you must include the *file-ref* parameter following the keyword REREAD. You may choose to include the USING parameter in which case you must also include either the *char-var* or *line-ref* parameter. You must include the colon, followed by at least one *data-item*. Note that you may list more than one *data-item*. You may choose to include either *EXIT line-ref* or *error-cond line-ref*.

In the first example, the optional parameters are omitted. Therefore the default actions are taken.

The syntax for a BASIC statement is as shown:



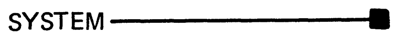
A keyword in a BASIC statement or system command must be followed by a blank except where a comma, parenthesis, or other appropriate delimiter is defined. Also a blank must follow the leading line number in a BASIC statement.

A label can be added to any BASIC statement except a DEF statement (see "Labels").

A remark can be added at the end of any system command or BASIC statement except a DATA statement (see "Remarks").

SYSTEM command

The SYSTEM command allows the operator to specify special functions for the communications feature.



System commands

The system commands are used for program management, execution, operations, and to control diskette and printer operations. System commands are instructions that the computer executes immediately. Commands are not part of a BASIC program and do not have line numbers. Commands may be entered either character-by-character from the keyboard and then executed by pressing the Enter key or, in some cases, the entire keyword may be entered by holding down the Cmd key and pressing the appropriate key. Using the Cmd key inserts the keyword by pressing a single key, providing faster operation and prevents keying errors. It should be noted that commands can be executed from the keyboard or a PROC, but not from a program. The commands direct the system to perform the following operations.

- Program execution—Start or resume execution of a BASIC program, procedure, or Customer Support Functions.
- Program management—Load or save programs or data on diskette. Display program status (name and storage).
- Program operation—List, edit, and renumber program statements or merge several programs into one.
- File management—Lists, renames, protects, drops, or frees files on a diskette.
- Set DATE and TIME.
- PRINT variables or expression results.
- Assign values to variables.

Parameters required for a command can be entered on the line after the command keyword. The command operation starts after the Enter key is pressed. The command keywords and their functions are:

ALERT	Alert the operator from a procedure file
AUTO	Automatic line numbering
CLEAR	Delete data or program from work area
DATE	Set the DATE$ variable
DEL	Delete lines of a BASIC program or data work area
DIR	List a file directory
DROP	Remove file data
FREE	Eliminate a file
GO	Resume interrupted processing
HELP STATUS	Display the name of the work area
LET	Assigns a value to a variable
LINK	Loads and executes Customer Support Functions
LIST	Display a BASIC program or data file work area
LISTP	Prints a list of lines in the work area
LOAD	Load a BASIC program or data file
MERGE	Merge a BASIC program and source file
PRINT	Displays data on screen or printer
PROC	Initiate command input from a procedure file
PROCERR	Directs system error handling
PROTECT	Write-protect a file, remove share restrictions, or close a file

System commands (continued)

RENAME	Rename a file
RENUM	Renumber lines
REPLACE	Save a program to an existing file
RUN	Run a BASIC program
SAVE	Save a BASIC program or data file
SKIP	Skip records within a procedure file
SORT	Execute SORT file
SUBPROC	Initiate input from a sub-procedure
SYSTEM	Specifies special communications feature functions
TIME	Set time of day
VOLID	List or change a diskette volume identification or access status

System functions

The System/23 BASIC language includes system functions (intrinsic functions) that perform a number of commonly used operations. In addition, the function can be defined and named by using the DEF statement (see ''DEF statement'').

The system functions can be used anywhere in a BASIC expression that constants, variables, or array element references can be used. See ''Arithmetic expressions''

Some of the functions have one or more arguments that produce a single result. An invalid argument will cause an error.

System function rules are as follows:

- Arithmetic expressions are indicated by X or M
- Character scalar arguments are indicated by A$, B$, or C$
- File reference numbers are indicated by N and can be arithmetic expressions. Non-integer values are rounded

Note: The arguments to system functions can be expressions that include function references.

See ''Program 4-Sample'' in Appendix A.

System functions (continued)

ABS(X)	Absolute value of X
AIDX(array name)	Ascending index of the source array
ATN(X)	ARC tangent of X
CEIL(X)	Next larger number
CHR$(X)	Position in native collating sequence
CON	Sets array to a constant and redimensions
COS(X)	Cosine of X
DIDX(array name)	Descending index of the source array
DISPLY(X)	Current screen display page
EXP(X)	E raised to X power
FILE(N)	Status of the file
FILE$(N)	File specification
FREESP(N)	Space available
INT(X)	X or next smaller number
HEX$(A$)	Character equivalent of hexadecimal value
KLN(N)	Key length of file N
KPS(N)	Key position of file N
LEN(A$)	Length of A$
LOG(X)	Natural log of X
LPAD$(C$,X)	Pad with blanks on left
LTRN$(C$)	Trim blanks from left
MAX(X1,X2,...)	Maximum value of list
MIN(X1,X2,...)	Minimum value of list
ORD(A$)	Collating location of A$
PIC$(C$)	Return or set PIC currency symbol
POS(A$,B$,X)	Substring location
REC(N)	Last record number used in file N
RLN(N)	Record length
RND[(X)],	Random number

ROUND(X,M)	Rounded value of X
RPAD$(A$,X)	Pad with blanks on right
RPT$(A$,M)	Repeat string A$
RTRM$(A$)	Trim blanks from right
SGN(X)	Sign of X
SHIFT(X)	Returns machine type or sets shift mode
SIN(X)	Sine of X
SQR(X)	Square root of X
SRCH	Search table
SREP$	Replaces substring
STR$(X)	Character string representation of X
TAN(X)	Tangent of X
UDIM(array,X)	Highest subscript of array
VAL(A$)	Numeric equivalent of numeric representation
WSID$	Shared 5246 port number
ZER	Zero array and redimension

System keywords

see

"System commands"
"Reserved words"

System variables

The system variables are used by the system to aid in time stamping, program control, and error recovery. System variables are maintained by the system. They cannot be the target of an assignment, nor can they be referenced in a substring operation. Otherwise, they may be used in any context where a user variable is allowed.

The following are system variables that are set to arithmetic values:

- CMDKEY—INPUT/LINPUT termination code
- CNT—I/O variable count
- CODE—Program termination code
- ERR—Error code
- FILENUM—Last file causing an error
- LINE—Last program line number causing an error
- PROCIN—Is RUN PROC active?

The following are system variables that are set to character values:

- DATE$—Value set by DATE command
- KSTAT$—Last key stroke
- TIME$—Current time of day
- WSID$--5246 attachment code

TAB function

see "PRINT statement"

Tables

see "Arrays"

TAN(X)

TAN returns the tangent of X, where X is in radians and is less than 1E10. Specify a value for X greater than -(PI/2) or less than PI/2 for best accuracy.

THEN

see "IF,THEN,ELSE statement"

TIME command

The TIME command is used to enter the time of day into the system. The system variable TIME$ is set to the value specified.

```
TIME—hh:mm:ss ———■
```

The syntax of the TIME command is as shown above, where:

hh:mm:ss specifies the time in hours, minutes, and seconds.

The time is set to 00:00:00 at power-on time.

The value of TIME$ wraps on 23:59:59 to 00:00:00. The DATE$ variable is not incremented.

TIME$

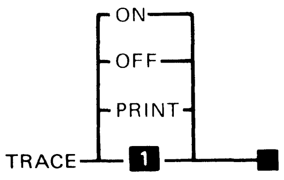
TIME$ returns an eight character string that is initialized by the TIME command and maintained by the system. At power-on, the value is set to 00:00:00.

Tips and techniques

see Appendix C

TRACE statement

The trace statement is used to trace all or part of a program's execution.



1 ON to display

The syntax of the TRACE statement is as shown above, where:

ON specifies that tracing is to be displayed on screen. This is the default.

OFF specifies that tracing is to be stopped.

PRINT specifies that tracing is to be printed on the system printer. PRINT cannot be used if device address 10 is OPEN to a file reference number other than #255. If TRACE PRINT is active, device 10 cannot be OPEN to any file reference number except #255 (see "Printer assignment").

To TRACE an entire program without modifying it, see "RUN command" (TRACE option).

Trim

see "LTRM$"
"RTRM$"

UDIM (array,X)

UDIM returns the value of the upper dimension X of the array, where X is either an integer 1 or an integer 2.

X=1 returns the row dimension
X=2 returns the column dimension

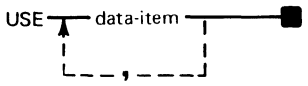
An error occurs if X is neither 1 nor 2, or if 2 is specified and the array is one-dimensional.

```
10 DIM A(5,3)
20 B = UDIM(A,1)
30 C = UDIM(A,2)
```

B contains 5 (row dimensions)
C contains 3 (column dimensions)

USE statement

The USE statement lists the variables passed from one program to another during chaining.



The syntax of the USE statement is as shown above, where:

data-item is the variable or array (without the keyword MAT) passed to the chained-to program. The list of data items is not syntax checked until the USE statement is executed.

The list of data items specified on the USE statement must exactly match those listed on the corresponding CHAIN statement. If an array or a character variable is passed during chaining, the array or the character variable must be dimensioned in the chained-to program to the same number of elements and string size to which it was DIMed in the chained-from program. The options of the chained-to program must be identical to the options of the chained-from program.

Only one USE statement is permitted in a program.

VAL(A$)

The numeric value associated with the string A$ is returned. If the conversion of the numeric representation results in a value that causes an underflow, then the value returned is zero. If the conversion of the numeric representation results in a value that causes an overflow, then the value returned is the largest number. If A$ is not a valid numeric representation, a CONV error will occur.

Variable names

All variable names must be unique. The same name used to designate an array, a variable, a function, or a label is not permitted.

There are three types of variable names. They are:

- Numeric variable or numeric array name
- Character variable or character array name
- Function names

Numeric variable or numeric array name

A numeric variable name or a numeric array name must start with an alphabetic character, followed by up to seven alphabetic or numeric characters. The name must be surrounded by blanks, commas, parentheses, or other delimiters as shown in the syntax. For example:

```
10 SALARY = 850
20 TAXRATE(3) =.22
```

Variable names

Character variable or character array name

A character variable name or character array name must start with an alphabetic character, followed by up to seven alphabetic or numeric characters and ending in a $. The name must be surrounded by blanks, commas, parentheses, or other delimiters as shown in the syntax. For example:

```
20 DIM ADDRESS$*20
30 ADDRESS$ = "22136 LARKSPUR TRAIL"
40 NAME$(3) = "SCOTT"
```

Function names

Function names must start with FN, followed by an alphabetic character, followed by up to seven alphabetic or numeric characters. The function name must end in a $ only if a character result is returned (see "DEF,FNEND statement").
For example:

```
50 DEF FNFICA(X)=.0613*X
60 DEDUCT=FNFICA(SALARY)
70 DEF FNCONNECT$(X$,Y$)=X$&Y$
80 PRINT FNCONNECT$(NAME$(3),ADDRESS$)
```

Note: Names which are already used in the BASIC language may not be used as variable names. All words beginning with FN are reserved words. (See "Reserved words".)

Variables, arithmetic

see "Arithmetic variables"

Variables, character

see "Character variables"

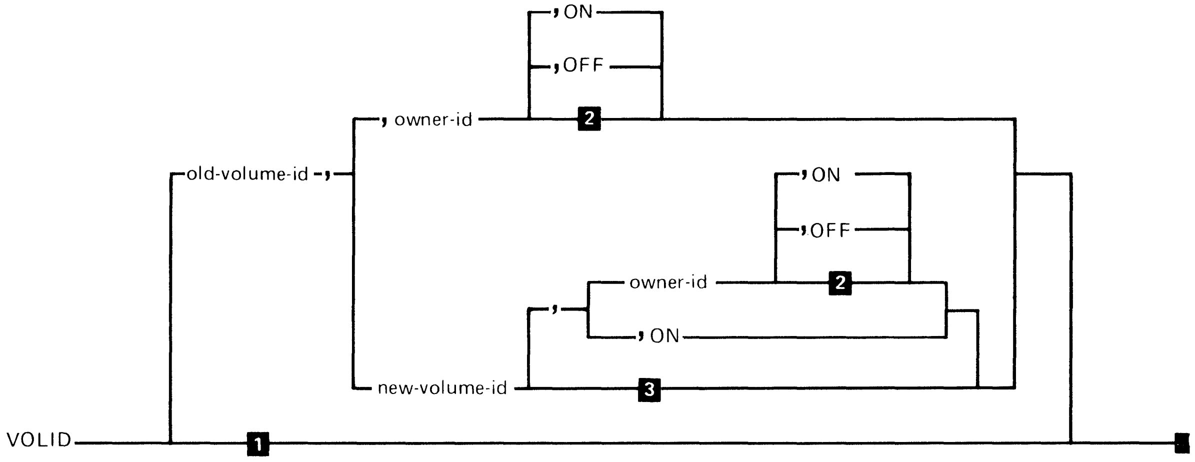
Variables, internal

see "System variables"

VOLID command

The VOLID command, if entered with parameters, is used to change a diskette volume identification, the owner identification, or the access state.

If no parameters are entered for the VOLID command, volume identification and owner identification for all diskettes currently inserted are displayed and unchanged.



1 Display current volume and owner identification
2 Protection off
3 Owner-id not changed

The syntax of the VOLID command is as shown above, where:

old-volume id specifies the volume to be changed.

new-volume id specifies the new volume identification for the diskette. This parameter can be from one to six

VOLID command (continued)

alphabetic or numeric characters. *New-volume id* is only necessary if the volume identification is being changed.

owner-id specifies the owner identification for the diskette. This entry can be up to 14 alphabetic or numeric characters. *Owner-id* is only necessary when the owner identification is being changed or when the OFF parameter is used.

ON specifies that the protection indicator for the volume is to be turned on, making the volume unaccessible.

OFF specifies that the protection indicator for the volume is to be turned off, making the volume accessible.

Do not change the VOLID of a diskette with files that are open and in use.

Example

```
VOLID DEBITS,DEBTS,ZEPOL,ON
```

In this example, the diskette volume identification of volume DEBITS is changed to DEBTS. The owner identification is changed to ZEPOL. The volume protection indicator is turned on.

```
VOLID DEBITS,,NEW
```

In this example, the owner identification of the volume DEBITS is changed to NEW. Notice that no *new-volume-id* is entered because the volume identification is not changed. However, a comma must still be entered as shown in the example. The extra comma indicates that a parameter is being skipped.

```
VOLID
1 MASTER PAYROLL
```

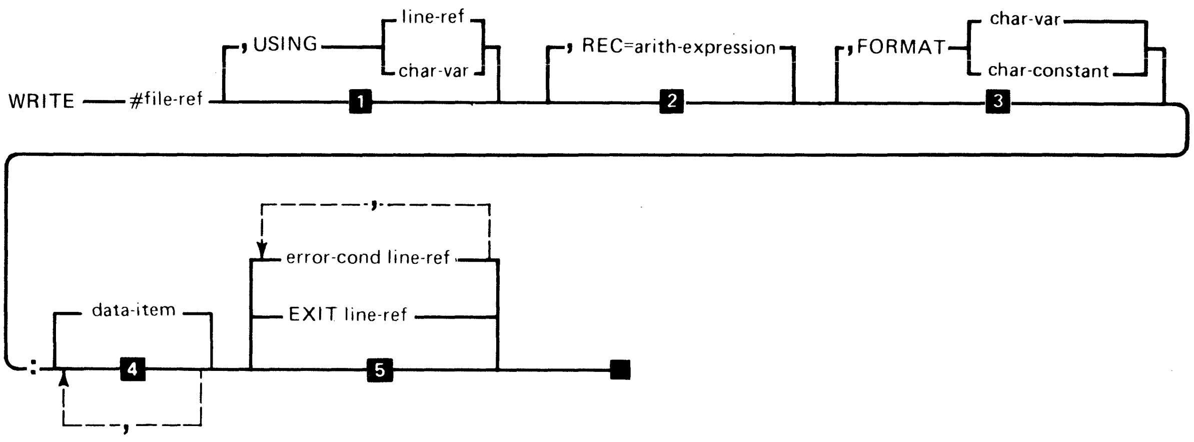
In this example, the VOLID command is entered alone and the volume ID and owner ID are displayed for the diskette in drive 1.

Work area

see "Storage use"

WRITE Statement

The WRITE statement is used to replace a deleted record or add a record to an internal file. The file may be opened for sequential, relative, or keyed access.



1 Unformatted write
2 Sequential file only. Add to the end of the file
3 Communications special control functions not in use
4 WRITE record with no data
5 Interrupt on error unless ON is active

The syntax for the WRITE statement is as shown, where:

file-ref is a numeric expression. See "File reference parameter".

USING specifies a line reference of a FORM statement or a character variable containing a FORM statement. *line-ref* can be a line number or label. The FORM statement is used to indicate the representation and location of the variables in the output.

REC= specifies the record having a record number equal to an arithmetic expression. This parameter must be used when RELATIVE is specified in the OPEN statement. When replacing a record, the record number refers to the deleted record. When adding a record, the record number is n + 1 (n is the total number of records in the file).

FORMAT is a Communications feature clause. It specifices that special control functions are requested. The control functions can be specified as a *char-constant* (character constant) or in a *char-var* (character variable).

data-item specifies the names of variables or expressions to be written to the file. The data-item can include variables, array elements, entire arrays (preceded by MAT), or numeric or character expressions. data-item must be separated by a comma and must be preceded by a colon.

error-cond line-ref specifies the line number or label that the program should transfer to if one of the error conditions occurs. The following error conditions may be included in any order:

- CONV - conversion error
- DUPREC - record already exists
- EOF - end of volume
- IOERR - input/output error
- NOREC - invalid record reference
- SOFLOW - string overflow

WRITE Statement (continued)

EXIT specifies the line number or label of an EXIT statement that the system references if an error occurs.

For related information, see ''Internal I/O file formatting'', ''READ statement'', ''OPEN statement'', ''FORM statement'', and I/O tables in Appendix B.

Programming considerations

- Added keyed records
  - The record is added to the master file and a pointer to it is added to the index file. Running the Index Customer Support Function is recommended to speed up subsequent file access. If the new index file record was created and the master file write is unsuccessful, the index file will contain an invalid entry. The condition will cause a NOREC error (no record found) on a subsequent READ KEY= for the record. To prevent the addition of a duplicate key, precede the WRITE with a READ KEY= and check for a NOKEY condition. The specification of no duplicate key in the Index Customer Support Function does not prevent the addition of duplicate keys.

- CLOSE statement
  - Execution of the WRITE statement does not always result in an immediate physical write to the diskette. To ensure that it will, a CLOSE can be issued. When a file is shared, only one program can write while the other program reads.

- Unspecified record locations
  - Unspecified record locations are written as blanks if a USING clause was present.

- KEY/SEARCH
  - The KEY/SEARCH position specification cannot be used.

- OPEN statement
  - OUTPUT or OUTIN must be specified on the OPEN INTERNAL statement.

- No data
  - If the I/O list is omitted, there will be no transfer of data from variables. A record will be written.

See "Program 5-Sample" in Appendix A.

WSID$

WSID$ returns a character value of length 2 to indicate to which port of the 5246 Diskette Unit the requesting System/23 is attached (see "Device sharing"). The possible values are:

01	Attached to port 1 of 5246 Diskette Unit, not attached to 5246 Diskette Unit, or 5246 Diskette Unit is powered off.
02	Attached to port 2 of 5246 Diskette Unit

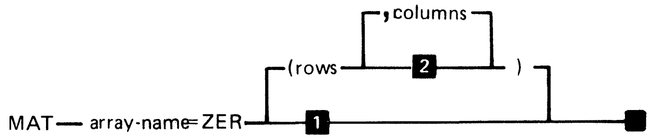
XREF

see "LIST label" under "LIST,LISTP command"

ZER and CON

ZER and CON are functions provided for matrixes.

ZER syntax



1 No redimensioning
2 Redimension to a one-dimensional array (vector)

The syntax for ZER is as shown, where:

array-name is the name of the array to be set to zero.

ZER sets all the elements of the array to zero.

row, columns are the redimensioning specifications for the array. Results are unpredictable if subscripted values are specified for rows and/or columns.

Example

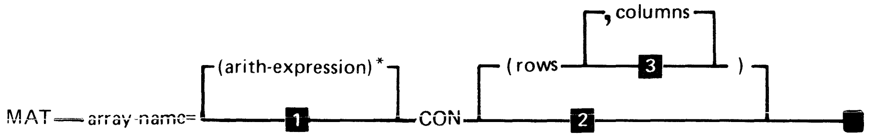
Assume array A is an array with four rows and four columns.

```
10 OPTION BASE 1
20 DIM A(4,4)
 •
 •
 •
250 MAT A=ZER(3,3)
```

array A before	array A after
1 2 3 4	0 0 0
2 3 4 5	0 0 0
3 4 5 6	0 0 0
4 5 6 7	

ZER and CON (continued)

CON syntax



1 1
2 No redimensioning
3 Redimension to one-dimensional array (vector)

The syntax for CON is as shown, where:

array-name is the name of the array to receive the constants.

arith-expression is a scalar arithmetic expression, which must be enclosed in parentheses.

CON sets all the values of *array-name* to the value of the arith-expression. If no arith-expression was specified, the default is 1.

rows, columns are the redimensioning specifications for the array. Results are unpredictable if subscripted values are specified for rows and/or columns.

Example

Assume array B is an array with 5 rows and 5 columns.

```
10 OPTION BASE 1
20 DIM B(5,5)
 •
 •
 •
250 MAT B=(3*2)*CON(3,4)
```

array B before	array B after
1 2 3 4 5	6 6 6 6
2 3 4 5 6	6 6 6 6
3 4 5 6 7	6 6 6 6
4 5 6 7 8	
5 6 7 8 9	

Notes:

Appendix A. Sample programs

Program 1 - Sample

```
00010 PRINT #255:"SAMPLE 1 PROGRAM";TAB(1)
00020 TRACE PRINT  ! .            TRACE, DISPLAY LINE NUMBERS WITH RESULTS
00030 PRINT #255:ABS(5),ABS(-5) ! ABS, ABSOLUTE VALUE SYSTEM FUNCTION
00040 PRINT #255:ATN(1) ! .     ARC TANGENT SYSTEM FUNCTION
00050 ! 4 ROW, 4 COLUMN ARITHMETIC ARRAY A, CHARACTER ARRAY C$
00060 ! (MAXIMUM STRING LENGTH 10)
00070 DIM A(3,3),C$(3,3)*10
00080 LET A(2,2)=5 ! .          ASSIGN NUMERIC ARRAY ELEMENT
00090 PRINT #255:A(2,2) ! .     PRINT NUMERIC ARRAY ELEMENT
00100 LET C$(2,2)="XYZ" ! .     ASSIGN NUMERIC ARRAY ELEMENT
00110 PRINT #255:C$(2,2) ! .    PRINT CHARACTER ARRAY ELEMENT
00120 PRINT #255:MAT A ! .      PRINT ENTIRE ARRAYS A AND C$
00130 PRINT #255:MAT C$ ! .     PRINT ENTIRE ARRAYS A AND C$
00140 PRINT #255:9.E+126,1.E-126 ! PRINT MAXIMUM AND MINIMUM NUMBERS
00150 PRINT #255:.123456789012345 ! PRINT FULL SIGNIFICANCE
00160 DATA 266,266.,266.00,.266E3,.266E+3,+.266E3,+.266E+3
00170 DATA +0.266E+003,+2.66E2,26.6E1,2660E-1,+26600E-2,.00266E5
00180 DIM N(2,3) !  .            DIM ARRAY FOR REPRESENTATION EXAMPLE
00190 READ MAT N ! .            READ DIFFERENT VERSIONS OF 266 INTO ARRAY N
00200 PRINT #255:MAT N ! .      PRINT RESULTS
00210 PRINT #255:1+2,1*2*3,(1+2)*3,(1+2)*(3+4)
00220 PRINT #255:1+2*3+4,1+2*3/4,(1+2)*(3/4),TAB(0),1+2*3/4,2**3
00230 PRINT #255:50+10**2/(2*(13+12))-2
00240 LET PAYMENT=122.3 ! .     ASSIGN NUMERIC VARIABLE
00250 LET TODAY=30
00260 LET VALUE=20
00270 PRINT #255:PAYMENT,VALUE,TODAY
00280 PRINT "PRESS INQ TO CONTINUE"
00290 ON ATTN GOTO ENDINQ !  .  INQ KEY CAUSES TRANFER TO ENDINQ
00300 TRACE OFF ! .                  STOP TRACE WHILE WAITING FOR INQ
00310 LET Z=0 ! CANNOT DETECT INQ ON A GOTO; MUST HAVE SOMETHING ELSE IN LOOP
00320 GOTO 310
00330 ENDINQ: ON ATTN IGNORE !  .    INQ KEY IGNORED
00340 TRACE PRINT  ! .                RESTART TRACE
00350 PRINT #255:CEIL(1.2);CEIL(-1.2),CEIL(5);CEIL(-5)
00360 LET D$="ABCD" ! .              INITIALIZE CHARACTER VARIABLE D$
00370 PRINT #255:D$,D$&"EF",D$(2:3) ! PRINT CHARACTER EXPRESSIONS
00380 LET D$(2:3)="XY" ! .           REPLACE "BC" WITH "XY"
00390 PRINT #255:D$
00400 LET D$(2:3)="12345" ! .        REPLACE "XY" WITH "12345"
00410 PRINT #255:D$
00420 LET D$(2:6)="" ! .             REPLACE 5 CHARACTERS WITH NULL
00430 PRINT #255:D$
```

Appendix A. Sample programs

Program 1 - Printed output

```
SAMPLE 1 PROGRAM

00030  5                 5
00040  .785398163397448
00080 00090  5
00100 00110 XYZ
00120
 0                       0                       0                       0
 0                       0                       0                       0
 0                       0                       5                       0
 0                       0                       0                       0
00130


                                                XYZ

00140  9.E+126           1.E-126
00150  .123456789012345
00190 00200
 266                     266                     266                     266
 266                     266                     266                     266
 266                     266                     266                     266
00210  3                 6                       9                       21
00220  11                2.5                     2.25
                         2.5                     8
00230  50
00240 00250 00260 00270  122.3                   20                      30
00280 00290 00300 00350  2 -1                    5 -5
00360 00370 ABCD        ABCDEF                  BC
00380 00390 AXYD
00400 00410 A12345D
00420 00430 AD
```

Program 2 - Sample

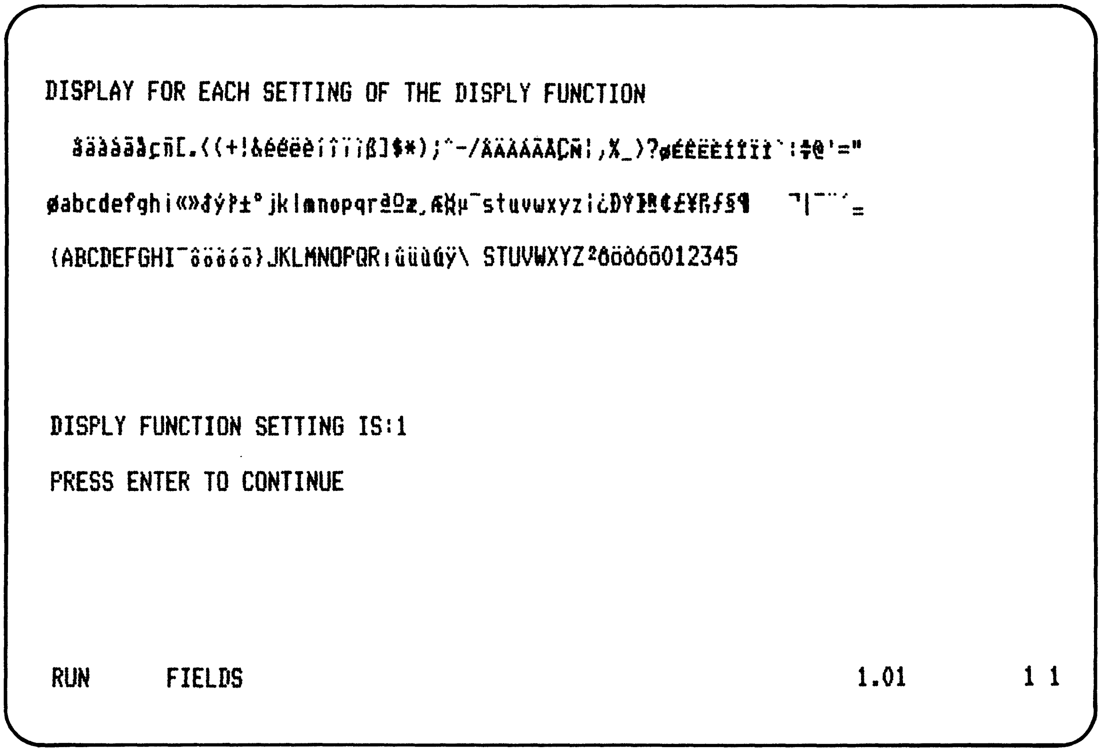
```
00010 PRINT #255:"SAMPLE 2 PROGRAM";TAB(1)
00020 TRACE PRINT
00030 PRINT HEX$("04");"HIGHLIGHT";HEX$("07");"BLINK";HEX$("08");"REVERSE";;
00040 PRINT HEX$("0A");"HIGHLIGHT,BLINK";HEX$("0B");"REVERSE,BLINK";HEX$("14")
00050 DIM E$*255
00060 TRACE OFF
00070 FOR I=64 TO 255 ! USE CHR$ TO GENERATE ALL LETTER GRAPHICS
00080 LET E$=E$&CHR$(I)I ! CATENATE EACH CHARACTER TO ACCUMULATED E$
00090 NEXT I
00100 PRINT NEWPAGE ! CLEAR SCREEN
00110 PRINT FIELDS "3,2,C 78":"DISPLAY FOR EACH SETTING OF THE DISPLY FUNCTION"
00120 PRINT FIELDS "5,2,C 64":E$(1:64) ! PRINT CONTENTS OF E$ (ALL CHARACTERS)
00130 PRINT FIELDS "7,2,C 64":E$(65:128)
00140 PRINT FIELDS "9,2,C 64":E$(129:182)
00150 FOR I=1 TO 5 ! SET DISPLY AND PRINT DISPLY SETTING; WAIT FOR ENTER
00160 PRINT FIELDS "15,2,C 78":"DISPLY FUNCTION SETTING IS:"&STR$(DISPLY(I))
00170 PRINT FIELDS "17,2,C 78":"PRESS ENTER TO CONTINUE"
00180 INPUT FIELDS "18,2,C 1":Z$
00190 NEXT I
00200 TRACE PRINT
00210 PRINT #255:"COSINE OF 1 RADIAN IS ";COS(1)
00220 DIM F(4),AINDEX(4),DINDEX(4)
00230 FOR I=0 TO 4 ! FILL F WITH RANDOM NUMBERS
00240 LET F(I)=RND
00250 PRINT #255:;
00260 NEXT I
00270 MAT AINDEX=AIDX(F) ! ASCENDING INDEX OF F
00280 MAT DINDEX=DIDX(F) ! DESENDING INDEX OF F
00290 FOR I=0 TO 4
00300 PRINT #255:;
00310 PRINT #255,USING 330:F(I),AINDEX(I),DINDEX(I),F(AINDEX(I)),F(DINDEX(I))
00320 NEXT I
00330 FORM N 17.15,X 2,N 1,X 2,N 1,X 2,N 17.15,N 17.15,SKIP 2I
00340 PRINT #255:"TAN(1)=";TAN(1),"TAN(PI/4)=";TAN(PI/4)
00350 PRINT #255:"CHARACTER AND NUMERIC DATA ";STR$(123.45)
00360 END
```

Appendix A. Sample programs

Program 2 - Printed output

```
SAMPLE 2 PROGRAM

00030 00040 00060 00210 COSINE OF 1 RADIAN IS  .540302305868036
00230 00240 00250
00260 00240 00250
00260 00240 00250
00260 00240 00250
00260 00240 00250
00260 00270 00280 00290 00300
00310  .131537788143166  0  1   .131537788143166 .755605322195030

00320 00300
00310  .755605322195030  4  3   .218959186328090 .532767237412170

00320 00300
00310  .458650131923449  2  2   .458650131923449 .458650131923449

00320 00300
00310  .532767237412170  3  4   .532767237412170 .218959186328090

00320 00300
00310  .218959186328090  1  0   .755605322195030 .131537788143166

00320 00340 TAN(1)= 1.5574077246552           TAN(PI/4)= .99999999999067
00350 CHARACTER AND NUMERIC DATA 123.45
00360
```

Program 2 - Display output



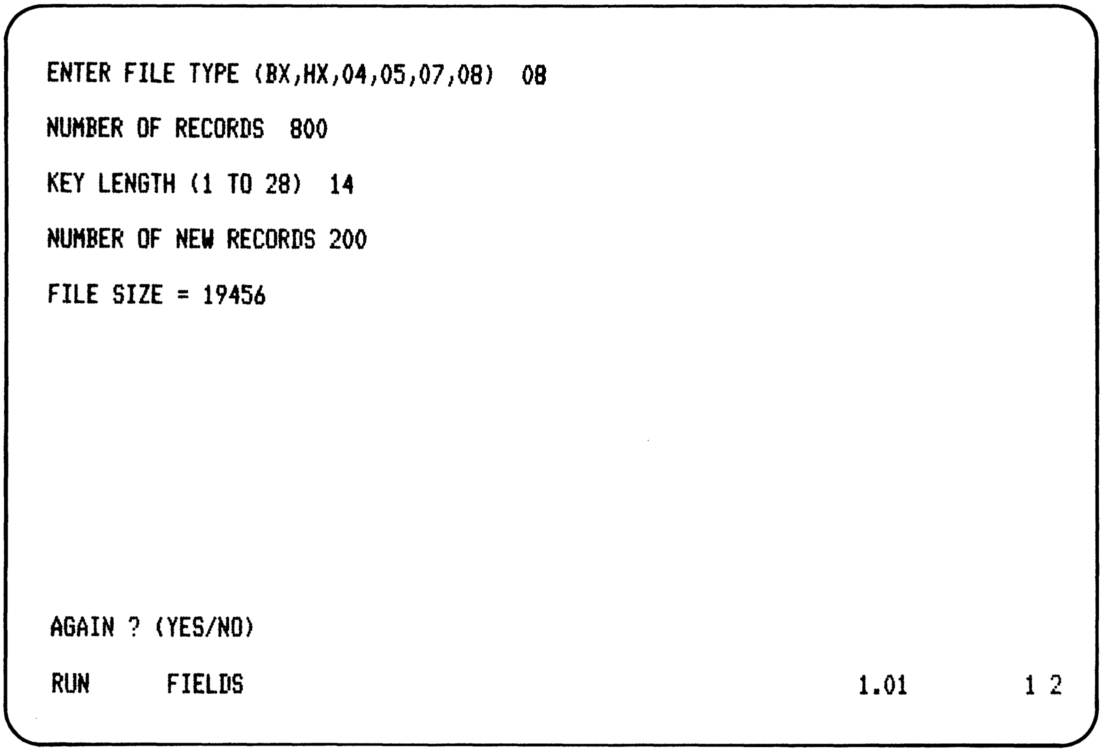
```
DISPLAY FOR EACH SETTING OF THE DISPLY FUNCTION

  âäàáãåçñ[.<(+!&éêëèíîïìß]$*);^-/ÂÄÀÁÃÅÇÑ¦,%_>?øÉÊËÈÍÎÏÌ`:#@'="

øabcdefghi«»ðýþ±°jklmnopqrªºæ¸Æ¤µ¯stuvwxyz¡¿ÐÝÞ®¢£¥₧ƒ§¶    ¬|¯¨´=

{ABCDEFGHI¯ôöòóõ}JKLMNOPQRıûüùúÿ\ STUVWXYZ²ÔÖÒÓÕ012345



DISPLY FUNCTION SETTING IS:1

PRESS ENTER TO CONTINUE



RUN      FIELDS                                          1.01        1 1
```

Appendix A. Sample programs

Program 3 - Sample

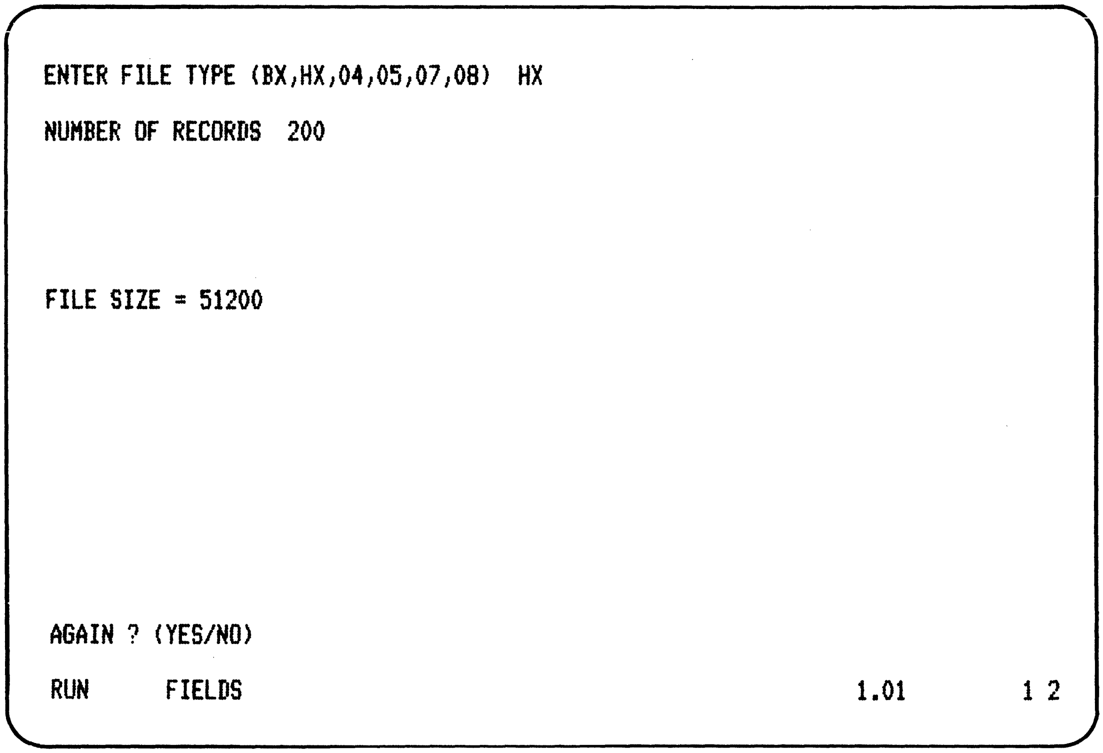
```
00010 OPTION BASE 1 ! SAMPLE3, DISKETTE FILE SIZE
00020 DIM FILETYPE$(6)*2
00030 DATA BX,HX,04,05,07,08
00040 READ MAT FILETYPE$
00050 PRINT NEWPAGE
00060 PRINT FIELDS "2,2,C 36":"ENTER FILE TYPE (BX,HX,04,05,07,08)"
00070 INPUT FIELDS "2,39,C 2":FTYPE$
00080 ON 1+SRCH(FILETYPE$,FTYPE$,1) GOTO 70,TBX,THX,T04,T05,T07,T08 NONE 70
00090 TBX: GOSUB INREC
00100 LET BYTES=128*RECORDS
00110 GOTO REPORT
00120 THX: GOSUB INREC
00130 LET BYTES=256*RECORDS
00140 GOTO REPORT
00150 T04: GOSUB INREC
00160 PRINT FIELDS "6,2,C 12":"RECORD SIZE"
00170 INPUT FIELDS "6,15,N 4":RSIZE
00180 IF RSIZE>4095 THEN GOTO 170
00190 LET BYTES=(1+RSIZE)*RECORDS
00200 GOTO REPORT
00210 T05: PRINT FIELDS "4,2,C 15":"NUMBER OF LINES"
00220 INPUT FIELDS "4,18,N 5":NLINES
00230 PRINT FIELDS "6,2,C 30":"AVERAGE LINE LENGTH (1 TO 255)"
00240 INPUT FIELDS "6,34,N 3":LINELGTH
00250 LET BYTES=LINELGTH*(1+NLINES)
00260 GOTO REPORT
00270 T08: !
00280 T07: GOSUB INREC
00290 PRINT FIELDS "6,2,C 20":"KEY LENGTH (1 TO 28)"
00300 INPUT FIELDS "6,24,N 2":KEYLGTH
00310 LET BYTES=512*CEIL(RECORDS/INT(512/(KEYLGTH+4))-1)
00320 IF FTYPE$="07" THEN GOTO REPORT
00330 PRINT FIELDS "8,2,C 21":"NUMBER OF NEW RECORDS"
00340 INPUT FIELDS "8,24,N 8":NEWRECS
00350 LET BYTES=BYTES+512*CEIL(NEWRECS/INT(510/(KEYLGTH+10)))
00360 GOTO REPORT
00370 !
00380 REPORT: PRINT FIELDS "10,2,C 30":"FILE SIZE = "&STR$(BYTES)
00390 PRINT FIELDS "22,2,C 16":"AGAIN ? (YES/NO)"
00400 INPUT FIELDS "22,20,C 3":ANSWER$
00410 IF ANSWER$="YES" THEN GOTO 50
00420 PRINT NEWPAGE
00430 STOP
00440 INREC: PRINT FIELDS "4,2,C 18":"NUMBER OF RECORDS"
00450 INPUT FIELDS "4,21,N 8":RECORDS
00460 RETURN
00470 END
```

Program 3 - Display output A



```
ENTER FILE TYPE (BX,HX,04,05,07,08)  08

NUMBER OF RECORDS  800

KEY LENGTH (1 TO 28)  14

NUMBER OF NEW RECORDS 200

FILE SIZE = 19456










AGAIN ? (YES/NO)

RUN      FIELDS                                           1.01        1 2
```

Program 3 - Display output B



```
ENTER FILE TYPE (BX,HX,04,05,07,08)  HX

NUMBER OF RECORDS  200





FILE SIZE = 51200












AGAIN ? (YES/NO)

RUN      FIELDS                                                   1.01         1 2
```

Program 4 - Sample

```
00010 PRINT #255:"SAMPLE 4 PROGRAM";TAB(1)
00020 TRACE PRINT
00030 DEF FNTIMESTMP$*30
00040 LET FNTIMESTMP$="DATE: "&DATE$&", TIME: "&TIME$
00050 FNEND
00060 PRINT #255:FNTIMESTMP$
00070 DEF FNTEST1(X)
00080 LET FNTEST1=X+FNTEST2(X)
00090 FNEND
00100 DEF FNTEST2(Y)
00110 LET FNTEST2=Y*Y
00120 FNEND
00130 PRINT #255:FNTEST1(3) ! RESULT IS 12
00140 DEF FNTEST3(Z)=Z+2
00150 PRINT #255:FNTEST3(6) ! RESULT IS 8
00160 PRINT #255:EXP(1);EXP(2);EXP(.5)
00170 PRINT #255:INT(1.5);INT(-1.5);INT(10)
00180 PRINT #255:LOG(1);LOG(EXP(1));LOG(10)
00190 LET A$="   ABC"
00200 PRINT #255:A$;A$;LEN(A$)
00210 PRINT #255:LTRM$(A$);LTRM$(A$),LEN(LTRM$(A$))
00220 LET B$="XYZ   "
00230 PRINT #255:B$;B$,LEN(B$)
00240 PRINT #255:RTRM$(B$);RTRM$(B$),LEN(RTRM$(B$))
00250 LET C$="DEF"
00260 PRINT #255:C$;C$,LEN(C$)
00270 PRINT #255:LPAD$(C$,10);LPAD$(C$,10),LEN(LPAD$(C$,10))
00280 PRINT #255:RPAD$(C$,10);RPAD$(C$,10),LEN(RPAD$(C$,10))
00290 PRINT #255:RPT$("GHI",3)
00300 PRINT #255:MIN(1,3,-5),MIN(-5,1,3)
00310 PRINT #255:POS ("ABCDCDE","DE",1)
00320 PRINT #255:POS ("ABCDCDE","CD",4)
00330 LET A=123.456789
00340 PRINT #255:A;ROUND(A,3);ROUND(A,0);ROUND(A,-2)
00350 PRINT #255:SGN(-3),SGN(0),SGN(23.2)
00360 PRINT #255:SIN(PI);SIN(2*PI);SIN(PI/2)
00370 PRINT #255:SQR(4);SQR(9);SQR(2)
00380 PRINT #255:ORD("A"),ORD("1")
00390 PRINT #255:SREP$("ABABCDEFG",3,"AB","XY")
00400 PRINT #255:10+VAL("12")
00410 END
```

Appendix A. Sample programs

Program 4 - Printed output

```
SAMPLE 4 PROGRAM

00030 00060 00040 00050 DATE:   /  /  , TIME: 00:02:25
00070 00100 00130 00080 00110 00120 00090  12
00140 00150  8
00160  2.718281828459  7.389056098931  1.6487212707
00170  1 -2  10
00180  0  .999999999999983  2.30258509299405
00190 00200    ABC   ABC 6
00210 ABCABC             3
00220 00230 XYZ   XYZ                              6
00240 XYZXYZ             3
00250 00260 DEFDEF       3
00270       DEF       DEF                          10
00280 DEF       DEF                                10
00290 GHIGHIGHI
00300 -5                -5
00310  6
00320  5
00330 00340  123.456789  123.457  123  100
00350 -1                 0                         1
00360  0 -1.E-14  1
00370  2  3  1.414213562373
00380  193               241
00390 ABXYCDEFG
00400  22
00410
```

Program 5 - Sample

```
00010 PRINT #255:"SAMPLE 5 - OPEN, CLOSE(FREE), INPUT, LINPUT"
00020 PRINT #255:"            READ, REREAD, WRITE, REWRITE";TAB(1)
00030 TRACE PRINT
00040 OPEN #1:"NAME=TEST.DISP/SAMPLE,SIZE=512",DISPLAY,OUTPUT
00050 PRINT #1:"LINE,1"
00060 PRINT #1:"LINE,2"
00070 CLOSE #1:
00080 OPEN #2:"NAME=TEST.DISP",DISPLAY,INPUT
00090 OPEN #3:"NAME=TEST.INT/SAMPLE,SIZE=512,RECL=21",INTERNAL,OUTPUT
00100 LINPUT #2:A$
00110 PRINT #255:A$
00120 LINPUT #2:A$
00130 PRINT #255:A$
00140 RESTORE #2:
00150 INPUT #2:A$,B
00160 PRINT #255:A$,B
00170 WRITE #3:A$,B
00180 INPUT #2:A$,B
00190 PRINT #255:A$,B
00200 WRITE #3:A$,B
00210 CLOSE #2,FREE:
00220 CLOSE #3:
00230 OPEN #3:"NAME=TEST.INT",INTERNAL,OUTIN
00240 READ #3:
00250 REREAD #3:A$,B
00260 PRINT #255:A$,B
00270 REWRITE #3:A$,B,"NEW"
00280 READ #3:A$,B
00290 PRINT #255:A$,B
00300 RESTORE #3:
00310 READ #3:A$,B,C$
00320 PRINT #255:A$,B,C$
00330 LET COUNT=CNT ! .          MUST SAVE CNT TO PRINT VALUE
00340 PRINT #255:CNT,"REAL VALUE OF CNT IS ";COUNT
00350 PRINT #255:"FILE(3) = ";FILE(3)
00360 PRINT #255:"FILE$(3) = ";FILE$(3)
00370 PRINT #255:"FREESP(3) = ";FREESP(3)
00380 PRINT #255:"WSID$ = ";WSID$
00390 PRINT #255:"REC(3) = ";REC(3)
00400 PRINT #255:"RLN(3) = ";RLN(3)
00410 CLOSE #3,FREE:
```

Program 5 - Printed output

```
SAMPLE 5 - OPEN, CLOSE(FREE), INPUT, LINPUT
           READ, REREAD, WRITE, REWRITE

00040 00050 00060 00070 00080 00090 00100 00110 LINE,1
00120 00130 LINE,2
00140 00150 00160 LINE   1
00170 00180 00190 LINE   2
00200 00210 00220 00230 00240 00250 00260 LINE   1
00270 00280 00290 LINE   2
00300 00310 00320 LINE   1                       NEW
00330 00340  0          REAL VALUE OF CNT IS  3
00350 FILE(3) =  0
00360 FILE$(3) = TEST.INT/SAMPLE/3
00370 FREESP(3) =  509
00380 WSID$ = 01
00390 REC(3) =  1
00400 RLN(3) =  21
00410
```

Program 6 - Sample

```
00010 PRINT #255:"SAMPLE 6 - ON ERROR, ERR, LINE, CONTINUE, RETRY"
00020 TRACE PRINT
00030 ON ERROR GOTO REPORT
00040 OPEN #1:"NAME=TEST2/SAMPLE,SIZE=512",DISPLAY,OUTPUT
00050 PRINT #1:"TEST RECORD"
00060 CLOSE #1:
00070 OPEN #1:"NAME=TEST2",DISPLAY,INPUT
00080 INPUT #1:A
00090 CLOSE #1,FREE:
00100 ON ZDIV GOTO FIXZDIV
00110 LET A=1
00120 LET B=0
00130 LET C=A/B
00140 PRINT #255:C
00150 STOP
00160 !
00170 REPORT: PRINT #255:"ERR=";ERR
00180 PRINT #255:"LINE=";LINE
00190 CONTINUE
00200 !
00210 FIXZDIV: LET B=1
00220 RETRY
00230 END
```

Appendix A. Sample programs

Program 6 - Printed output

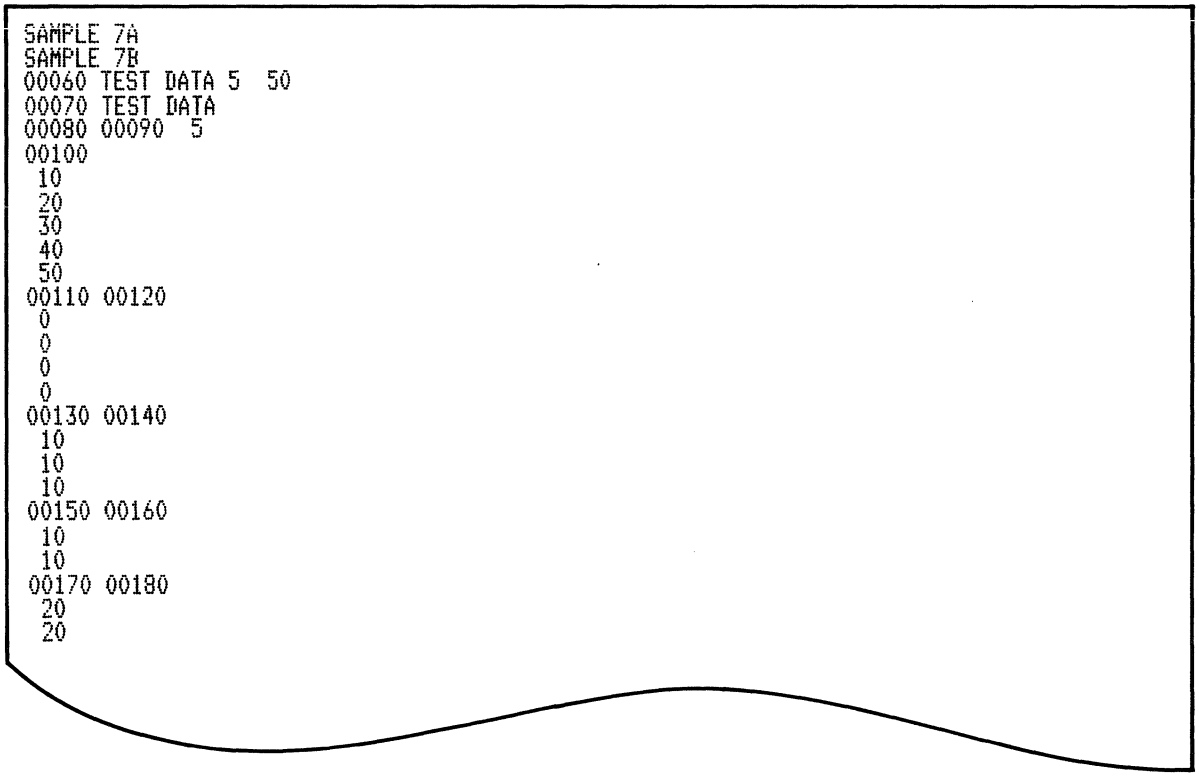
```
SAMPLE 6 - ON ERROR, ERR, LINE, CONTINUE, RETRY
00030 00040 00050 00060 00070 00080 00170 ERR= 726
00180 LINE= 80
00190 00090 00100 00110 00120 00130 00210 00220 00130 00140  1
00150
```

Program 7 - Sample

```
00010 PRINT #255:"SAMPLE 7A" ! INITIALIZE VARIABLES AND ARRAYS THEN CHAIN
00020 OPTION BASE 1
00030 DIM A$*18,C(5)
00040 LET A$="TEST DATA"
00050 LET B=5
00060 DATA 10,20,30,40,50
00070 READ MAT C
00080 OPEN #1:"NAME=CHAIN.TEST/SAMPLE,SIZE=512",DISPLAY,OUTPUT
00090 CHAIN "SAMPLE7B",FILES,A$,B,C
```

```
00010 DIM A$*18,C(5)
00020 USE A$,B,C ! PICK UP CHAINED VALUES AND FILE FROM SAMPLE 7A
00030 PRINT #255:"SAMPLE 7B"
00040 TRACE PRINT
00050 OPTION BASE 1 ! MUST BE SAME AS CHAINED FROM PROGRAM
00060 PRINT #255:A$;B;C(5)
00070 PRINT #255:A$
00080 CLOSE #1,FREE:
00090 PRINT #255:UDIM(C,1)
00100 PRINT #255:MAT C
00110 MAT C=ZER(4)
00120 PRINT #255:MAT C
00130 MAT C=(2*5)*CON(3)
00140 PRINT #255:MAT C
00150 MAT C=C(2)
00160 PRINT #255:MAT C
00170 MAT C=C+C
00180 PRINT #255:MAT C
```

Program 7 - Printed output (continued)



```
SAMPLE 7A
SAMPLE 7B
00060 TEST DATA 5  50
00070 TEST DATA
00080 00090  5
00100
 10
 20
 30
 40
 50
00110 00120
 0
 0
 0
 0
00130 00140
 10
 10
 10
00150 00160
 10
 10
00170 00180
 20
 20
```

Program 8 - Sample

```
00010:LOAD SAMPLE8.BUILD ! PROCEDURE TO DRIVE SAMPLE 8
00020:RUN
00030:LINK INDEX
00040:MESSAGES=1
00050:CHOICE=2
00060:MASFILE=TEST.MASTER
00070:KEYSTART=9
00080:KEYLGTH=5
00090:IDXFILE=TEST.INDEX
00100:IDXVOLID=SAMPLE
00110:DUPKEY=N
00120:ENDLINK
00130:LOAD SAMPLE8.TEST
00140:RUN
00150:PRINT #255:"END SAMPLE 8"
```

```
00010 PRINT #255:"SAMPLE8.BUILD"
00020 OPEN #1:"NAME=TEST.MASTER/SAMPLE,SIZE=512,RECL=22",INTERNAL,OUTPUT
00030 WRITE #1,USING FORMK:"RECORD 1","SMITH",12.34
00040 WRITE #1,USING FORMK:"RECORD 2","JONES",56.78
00050 WRITE #1,USING FORMK:"RECORD 3","BURNS",0
00060 CLOSE #1:
00070 FORMK: FORM C 8,C 6,N 8.2
00080 END
```

```
00010 PRINT #255:"SAMPLE8.TEST"
00020 TRACE PRINT
00030 LET A$=PIC$("$") ! INITIALIZE CURRENCY SYMBOL
00040 OPEN #1:"NAME=TEST.MASTER,KFNAME=TEST.INDEX",INTERNAL,INPUT ,KEYED
00050 PRINT #255:KLN(1),KPS(1) ! KEY POSITION , KEY LENGTH
00060 READ #1,USING FORMR,KEY="JONES":A$,NAME$,AMOUNT
00070 FORMR: FORM C 8,C 6,N 8
00080 PRINT #255,USING FORMP:AMOUNT
00090 FORMP: FORM PIC($###.##)
00100 PRINT #255:PIC$("X") ! SET CURRENCY SYMBOL TO "X"
00110 PRINT #255,USING FORMP:AMOUNT
00120 READ #1,KEY="BAKER": EXIT EXIT1
00130 STOP
00140 EXIT1: EXIT  NOKEY PRINTERR
00150 STOP
00160 PRINTERR: PRINT #255:"KEY NOT FOUND"
00170 CLOSE #1,FREE: ! FREE TEST FILE
```

Program 8 - Printed output

```
SAMPLE8.BUILD
SAMPLE8.TEST
00030 00040 00050  5     9
00060 00080 $056.78
00100 X
00110 X056.78
00120 00160 KEY NOT FOUND
00170
END SAMPLE 8
```

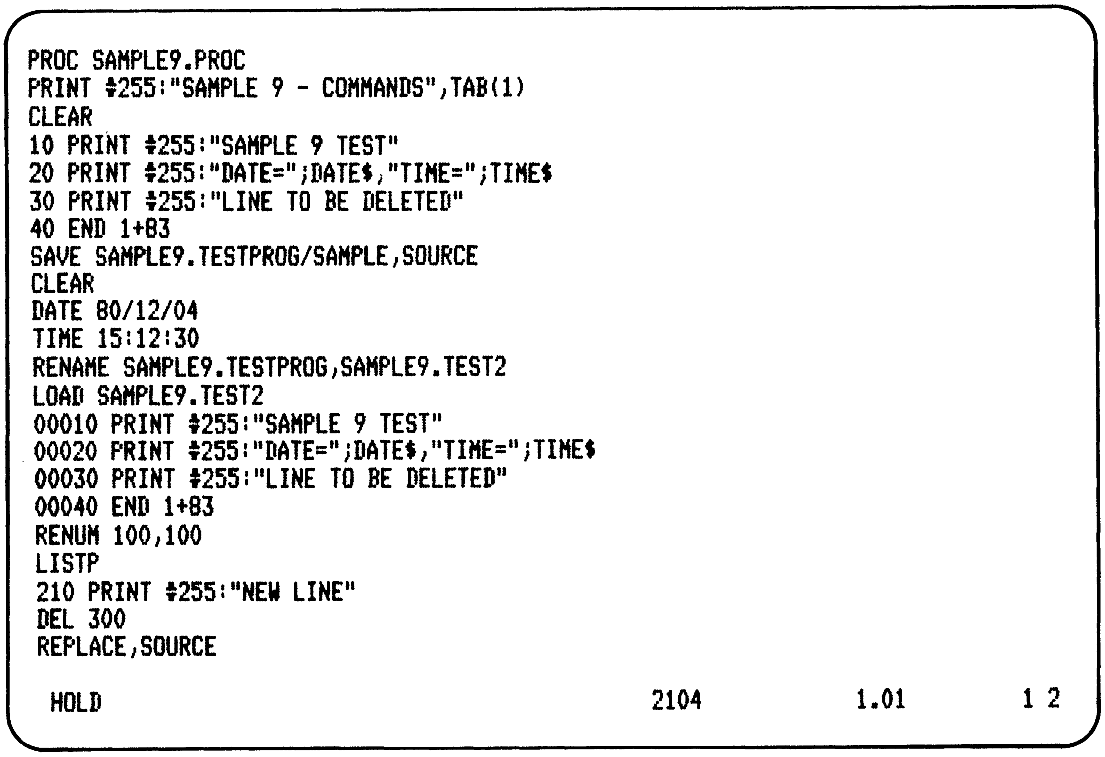
Program 9 - Sample

```
PRINT #255:"SAMPLE 9 - COMMANDS",TAB(1)
CLEAR
10 PRINT #255:"SAMPLE 9 TEST"
20 PRINT #255:"DATE=";DATE$,"TIME=";TIME$
30 PRINT #255:"LINE TO BE DELETED"
40 END 1+83
SAVE SAMPLE9.TESTPROG/SAMPLE,SOURCE
CLEAR
DATE 80/12/04
TIME 15:12:30
RENAME SAMPLE9.TESTPROG,SAMPLE9.TEST2
LOAD SAMPLE9.TEST2
RENUM 100,100
LISTP
210 PRINT #255:"NEW LINE"
DEL 300
REPLACE,SOURCE
LISTP
RUN TRACEP
PRINT #255:CODE
SKIP 1 IF CODE=84
ALERT CODE NOT SET PROPERLY
FREE SAMPLE9.TEST2
PRINT #255:"END SAMPLE 9"
```

Program 9 - Printed output

```
SAMPLE 9 - COMMANDS

00100 PRINT #255:"SAMPLE 9 TEST"
00200 PRINT #255:"DATE=";DATE$,"TIME=";TIME$
00300 PRINT #255:"LINE TO BE DELETED"
00400 END 1+83
00100 PRINT #255:"SAMPLE 9 TEST"
00200 PRINT #255:"DATE=";DATE$,"TIME=";TIME$
00210 PRINT #255:"NEW LINE"
00400 END 1+83
00100 SAMPLE 9 TEST
00200 DATE=80/12/04     TIME=15:12:50
00210 NEW LINE
00400
 84
END SAMPLE 9
```

Program 9 - Display output A



```
PROC SAMPLE9.PROC
PRINT #255:"SAMPLE 9 - COMMANDS",TAB(1)
CLEAR
10 PRINT #255:"SAMPLE 9 TEST"
20 PRINT #255:"DATE=";DATE$,"TIME=";TIME$
30 PRINT #255:"LINE TO BE DELETED"
40 END 1+83
SAVE SAMPLE9.TESTPROG/SAMPLE,SOURCE
CLEAR
DATE 80/12/04
TIME 15:12:30
RENAME SAMPLE9.TESTPROG,SAMPLE9.TEST2
LOAD SAMPLE9.TEST2
00010 PRINT #255:"SAMPLE 9 TEST"
00020 PRINT #255:"DATE=";DATE$,"TIME=";TIME$
00030 PRINT #255:"LINE TO BE DELETED"
00040 END 1+83
RENUM 100,100
LISTP
210 PRINT #255:"NEW LINE"
DEL 300
REPLACE,SOURCE

 HOLD                                        2104          1.01         1 2
```

Appendix A. Sample programs

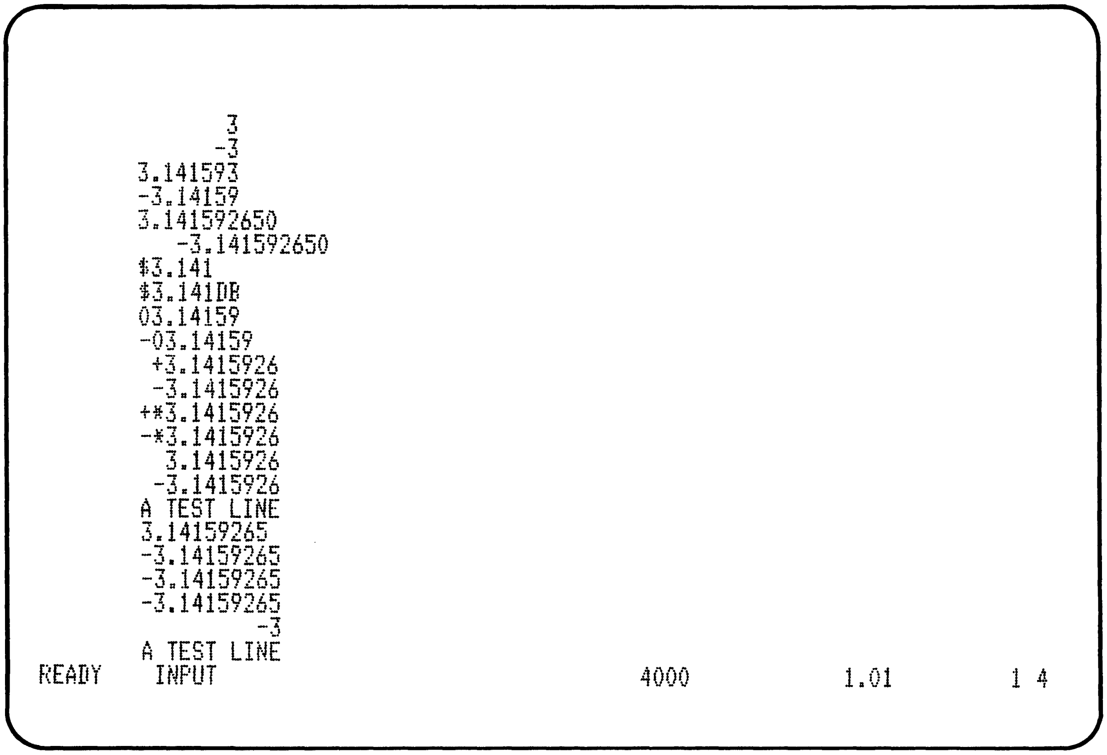
Program 10-Sample

Full screen processing.

```
00010 PRINT NEWPAGE
00020 LET I=3.14159265
00030 LET A$="A TEST LINE"
00040 LET J=-I
00050 PRINT FIELDS "1,10,N 8,N,N":I
00060 PRINT FIELDS "2,10,N 8,N,N":J
00070 PRINT FIELDS "3,10,N 8.6,N,N":I
00080 PRINT FIELDS "4,10,N 8.5,N,N":J
00090 PRINT FIELDS "5,10,N 11.9,N,N":I
00100 PRINT FIELDS "6,10,N 15.9,N,N":J
00110 PRINT FIELDS "7,10,PIC($$.###),N,N":I
00120 PRINT FIELDS "8,10,PIC($$.###DB),N,N":J
00130 PRINT FIELDS "9,10,PIC(##.#####),N,N":I
00140 PRINT FIELDS "10,10,PIC(+##.#####),N,N":J
00150 PRINT FIELDS "11,10,PIC(+++.########),N,N":I
00160 PRINT FIELDS "12,10,PIC(+++.########),N,N":J
00170 PRINT FIELDS "13,10,PIC(+*#.########),N,N":I
00180 PRINT FIELDS "14,10,PIC(+*#.########),N,N":J
00190 PRINT FIELDS "15,10,PIC(---.########),N,N":I
00200 PRINT FIELDS "16,10,PIC(---.########),N,N":J
00210 PRINT FIELDS "17,10,C 11":A$
00220 PRINT FIELDS "18,10,C 11":STR$(I)
00230 PRINT FIELDS "19,10,C 11":STR$(J)
00240 PRINT FIELDS "20,10,V 11":STR$(J)
00250 PRINT FIELDS "21,10,G 11":STR$(J)
00260 PRINT FIELDS "22,10,G 11":J
00270 PRINT FIELDS "23,10,G 11":A$
00280 END
```

Program 10-Display output

Full screen processing.



```
00050                    3
00060                   -3
00070             3.141593
00080             -3.14159
00090             3.141592650
00100                -3.141592650
00110             $3.141
00120             $3.141DB
00130             03.14159
00140             -03.14159
00150              +3.1415926
00160              -3.1415926
00170             +*3.1415926
00180             -*3.1415926
00190               3.1415926
00200              -3.1415926
00210             A TEST LINE
00220             3.14159265
00230             -3.14159265
00240             -3.14159265
00250             -3.14159265
00260                      -3
00270             A TEST LINE
          READY    INPUT                                 4000            1.01         1 4
```

Appendix A. Sample programs

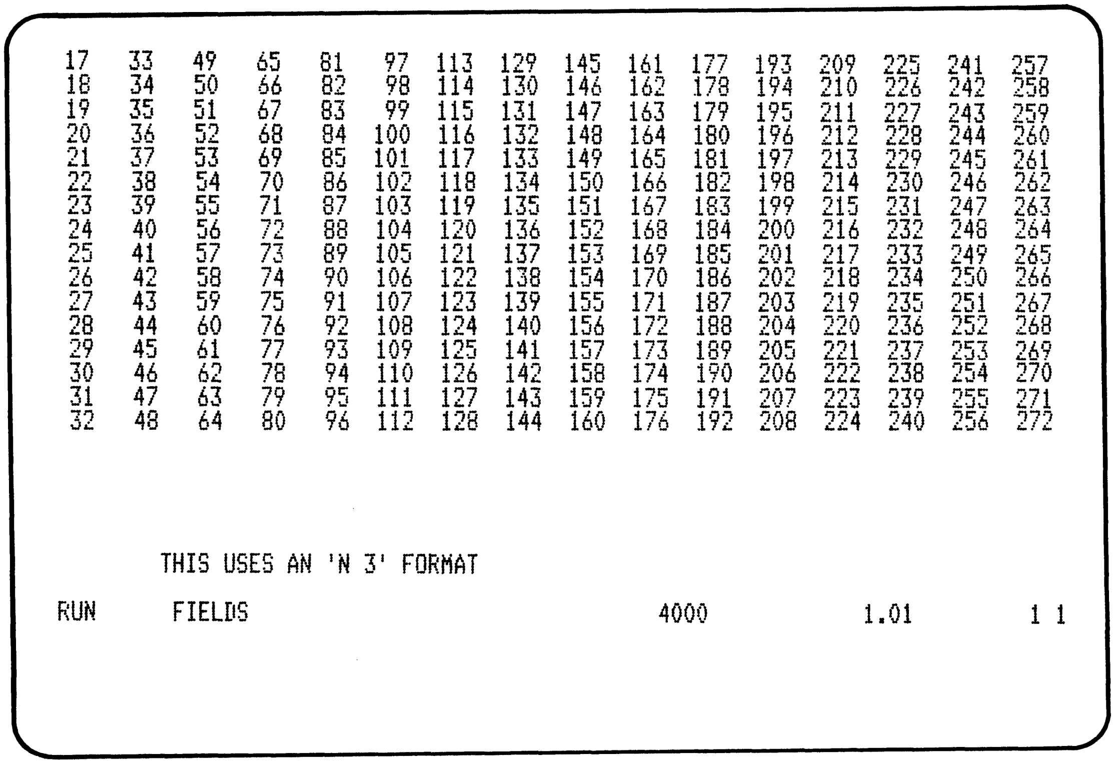
Program 11-Sample

Full screen processing.

```
00010 REM FULL SCREEN PROCESSING WITH THE "N X" FORMAT
00020 OPTION BASE 1
00030 DIM B$(16,16)*13,A(16,16)
00040 FOR I=1 TO 16 ! BUILD THE FIELD DEFINITION
00050 FOR J=1 TO 16 ! AND DATA ARRAYS
00060 LET B$(I,J)=STR$(I)&","&STR$(5*(J-1)+2)&",N 3,U,N"
00070 LET A(I,J)=16*J+I
00080 NEXT J
00090 NEXT I
00100 MAT B$=B$(256) ! REDIMENSION THE CONTROL ARRAY
00110 PRINT NEWPAGE
00120 PRINT FIELDS MAT B$:MAT A
00130 PRINT FIELDS "22,10,C 50":"THIS USES AN 'N 3' FORMAT"
00140 INPUT FIELDS "22,70,N 1,U,N":I ! WAIT FOR OUTPUT
00150 END
```

Program 11-Display output

Full screen processing.



```
 17  33  49  65  81  97 113 129 145 161 177 193 209 225 241 257
 18  34  50  66  82  98 114 130 146 162 178 194 210 226 242 258
 19  35  51  67  83  99 115 131 147 163 179 195 211 227 243 259
 20  36  52  68  84 100 116 132 148 164 180 196 212 228 244 260
 21  37  53  69  85 101 117 133 149 165 181 197 213 229 245 261
 22  38  54  70  86 102 118 134 150 166 182 198 214 230 246 262
 23  39  55  71  87 103 119 135 151 167 183 199 215 231 247 263
 24  40  56  72  88 104 120 136 152 168 184 200 216 232 248 264
 25  41  57  73  89 105 121 137 153 169 185 201 217 233 249 265
 26  42  58  74  90 106 122 138 154 170 186 202 218 234 250 266
 27  43  59  75  91 107 123 139 155 171 187 203 219 235 251 267
 28  44  60  76  92 108 124 140 156 172 188 204 220 236 252 268
 29  45  61  77  93 109 125 141 157 173 189 205 221 237 253 269
 30  46  62  78  94 110 126 142 158 174 190 206 222 238 254 270
 31  47  63  79  95 111 127 143 159 175 191 207 223 239 255 271
 32  48  64  80  96 112 128 144 160 176 192 208 224 240 256 272



        THIS USES AN 'N 3' FORMAT

RUN      FIELDS                          4000          1.01          1 1
```

Appendix A. Sample programs

Program 12-Sample

Full screen processing.

```
00010 REM VARIABLE OPEN OF 4 FILES ON 4 DRIVES
00020 DIM REC$*25
00030 LET J=10
00040 LET K=24
00050 FOR I=1 TO 4 ! OPEN A FILE ON EACH DRIVE
00060 LET FILEN$="FILE"&STR$(5-I)&"//"&STR$(I)
00070 REM FILE3 ON DRIVE 2, FILE1 ON DRIVE 4, ETC
00080 OPEN #I:"NAME="&FILEN$&",SIZE="&STR$(J*K*80)&",RECL=80",INTERNAL,OUTPUT
00090 NEXT I
00100 LET REC$="THIS IS A TEST RECORD"
00110 FOR J=1 TO 100 ! WRITE 100 RECORDS TO EACH FILE
00120 FOR I=1 TO 4
00130 WRITE #I,USING 140:REC$&"   RECORD NUMBER "&STR$(J)&" ON FILE "&STR$(I)
00140 FORM C 80
00150 NEXT I
00160 NEXT J
00170 FOR I=1 TO 4 ! CLOSE THE FILES
00180 CLOSE #I:
00190 NEXT I
00200 END
```

Appendix B. Tables

Tables

Appendix B. Tables

Tables (continued)

	0	1	2	3	4	5	6	7	8	9
0										
1			Note 2					Note 1		
2								|		
3			┘	┴	├					
4	┬	┌		Note 1	└				┐	┤
5			─							
6			+				â	ä	à	á
7	ã	å	ç	ñ	[	.	<	(	+	!
8	&	é	ê	ë	è	í	î	ï	ì	β
9	]	$	*	)	;	^	–	/	Â	Ä
10	À	Á	Ã	Å	Ç	Ñ	¦	,	%	_
11	>	?	ϕ	É	Ê	Ë	È	Í	Î	Ï
12	Ì	`	:	#	@	'	=	"	ϕ	a
13	b	c	d	e	f	g	h	i	≪	≫
14	đ	ý	þ	±	•	j	k	l	m	n
15	o	p	q	r	ª	º	æ	¸	Æ	¤
16	μ	~	s	t	u	v	w	x	y	z
17	i	¿	Đ	Ý	Ɨ	®	¢	£	¥	₧
18	ƒ	§	¶	¼	½	¾	¬	|	¯	¨
19	´	‗	{	A	B	C	D	E	F	G
20	H	I	¯	ô	ö	ò	ó	õ	}	J
21	K	L	M	N	O	P	Q	R	ı	û
22	ü	ù	ú	ÿ	\		S	T	U	V
23	W	X	Y	Z	²	Ô	Ö	Ò	Ó	Õ
24	0	1	2	3	4	5	6	7	8	9
25	³	Û	Ü	Ù	Ú					

Table 1. Decimal code to print character conversion

Notes:

1. Unprintable character
2. Page advance

Use table from left to right

Examples:
decimal code 193 prints **A**
decimal code 91 prints **$**

The information in this table is used with **CHR$**

The following tables specify the response of the System/23 to any combination of two I/O statements. Statements which are not listed in the table are considered errors.

Previous I/O statement	**Following I/O statement**		
	READ	**REREAD**	**RESTORE**
READ	next sequential record	previous record read	position to beginning
REREAD	next sequential record	previous record read	position to beginning
RESTORE	first record	error	position to beginning

Table 2. OPEN, INTERNAL, SEQUENTIAL, INPUT

Tables (continued)

Previous I/O statement	Following I/O statement	
	WRITE	RESTORE
WRITE	add record at the end	position to beginning
RESTORE	record is written as first and only	position to beginning

Table 3. OPEN, INTERNAL, SEQUENTIAL, OUTPUT

Previous I/O statement	Following I/O statement**				
	READ	REREAD	REWRITE	RESTORE	DELETE
READ or REREAD	next sequential record	read previous record	update previous READ	position to beginning	delete record previously read
DELETE or REWRITE	read next sequential record	error	error	position to beginning	error
RESTORE	read first record	error	error	position to beginning	error

*Initial position at beginning of file
**Error for diskette files on a WRITE

Table 4. OPEN, INTERNAL, SEQUENTIAL, OUTIN*

Previous I/O statement	Following I/O statement				
	READ	**READ* REC=n_2**	**REREAD**	**RESTORE**	**RESTORE* REC=n_2**
READ or REREAD	next sequential record	read record n_2	read previous record	position to beginning	position to record n_2
READ* REC=n_1	next sequential record	read record n_2	read previous record	position to beginning	position to record n_2
RESTORE	read first record	read record n_2	error	position to beginning	position to record n_2
RESTORE* REC=n_1	read record n_1	read record n_2	error	position to beginning	position to record n_2

*NOREC error if record is nonexistent or deleted.

Table 5. OPEN, INTERNAL, RELATIVE, INPUT

The WRITE statement must have a REC= clause. The WRITE must be directed to a deleted record in the file or to record n+1, where n is the last record. If a WRITE REC= is followed by a WRITE REC=, a record is added. If the record specified already exists, a DUPREC error occurs. A RESTORE to a relative file open for output is an error.

Table 6. OPEN, INTERNAL, RELATIVE, OUTPUT

Tables (continued)

Previous I/O statement	READ	READ REC=n_2*	RE-READ	WRITE REC=n_2**	RE-WRITE	RE-WRITE REC=n_2*	DELETE	DE-LETE REC=n_2	RE-STORE	RE-STORE REC=n_2*
READ or REREAD	read next sequential record	read record n_2	read previous record	add record n_2	update previous record read	update record n_2	delete previous record read	delete record n_2	position to beginning	position at record n_2
READ REC=n_1	read next sequential record	read record n_2	read record n_1	add record n_2	update record n_1	update record n_2	delete record n_1	delete record n_2	position to beginning	position at record n_2
Note	read next sequential record	read record n_1	error	add record n_2	error	update record n_2	error	delete record n_2	position to beginning	position at record n_2
Restore	read first record	read record n_2	error	add record n_2	error	update record n_2	error	delete record n_2	position to beginning	position at record n_2
RESTORE REC=n_1	read record n_2	read record n_2	error	add record n_2	error	update record n_2	error	delete record n_2	position to beginning	position at record n_2

Note: This line applies to: WRITE, REC=n_1
REWRITE
REWRITE, REC=n_1
DELETE
DELETE, REC=n_1

*If a record does not exist a NOREC error occurs
**If a record already exists a DUPREC error occurs

Table 7. OPEN, INTERNAL, RELATIVE, OUTIN

Previous I/O statement	Following I/O statement				
	READ	**READ* KEY/ SEARCH**	**REREAD**	**RESTORE**	**RESTORE* KEY/ SEARCH**
READ	read next record by key	read specified record	read previous record	position to first key	position to specified record
READ KEY= SEARCH=	read next record by key	read specified record	read previous record	position to first key	position to specified record
REREAD	read next record by key	read specified record	read previous record	position to first key	position to specified record
RESTORE	read first record by key	read specified record	error	position to first key	position to specified record
RESTORE KEY= SEARCH=	read record restored to	read specified record	error	position to first key	position to specified record

*If there is no KEY to match then a NOKEY error occurs

Table 8. OPEN, INTERNAL, KEYED, INPUT

If A WRITE is followed by a WRITE, a record is added.

Table 9. OPEN, INTERNAL, KEYED, OUTPUT

Appendix B. Tables

Tables (continued)

	Following I/O statement									
Previous I/O statement	READ	READ* KEY/ SEARCH	RE- READ	RE- WRITE	RE- WRITE* KEY=	DE- LETE	RE- STORE	RE- STORE* KEY/ SEARCH	DE- LETE* KEY=	WRITE
READ or READ KEY/ SEARCH or REREAD	read next record by key	read specified record	read pre- vious record	update pre- vious record read	update specified record	delete pre- vious record read	position to first key	position to specified key	delete specified record	add record by key
REWRITE or REWRITE KEY= or DELETE or DELETE KEY= or WRITE	read next record by key		error	error		error				
RESTORE	read first record by key		error	error		error				
RESTORE KEY/ SEARCH n_2	read record n_2	q	error	error		error				

*If there is no key to match, then a NOKEY error occurs

Table 10. OPEN, INTERNAL, KEYED, OUTIN

Previous I/O statement	Following I/O statement		
	INPUT	**LINPUT**	**RESTORE**
INPUT	next logical line	next logical line	position to beginning
LINPUT	next logical line	next logical line	position to beginning
RESTORE	first logical line	first logical line	position to beginning

Table 11. OPEN, DISPLAY, INPUT

Previous I/O statement	Following I/O statement	
	PRINT	**RESTORE**
PRINT	next logical line written	position to beginning
RESTORE	first logical line written	position to beginning

Table 12. OPEN, DISPLAY, OUTPUT

Appendix C. Performance tips and techniques

Introduction

This appendix is intended to identify areas that significantly affect program and system performance. Performance is enhanced if it is initially designed carefully and thoughtfully.

Flow diagrams are very helpful in designing efficient-running systems. There are many publications on flowcharting and other design aids that you may find helpful if you are not already familiar with these techniques.

Appendix C. Performance tips and techniques

BASIC statements and functions

A functionally enriched BASIC language has been implemented on System/23. This makes it possible to achieve the same results with various combinations of BASIC statements. Pay close attention to the complete set of options provided by each BASIC statement and, in particular, to the specially provided set of 45 system functions. Making use of system functions can eliminate many lines of program statements thereby improving processing time. Performance can also be enhanced by careful selection and use of the BASIC statements.

This section contains general comments on the use of BASIC to assist you in selecting combinations of statements and functions. Many of the following comments and examples will become noticeably significant when processed repetitively in loops or collectively with other statements.

Statement length (255 characters)

Combine statements where possible to take advantage of the 255 character maximum statement length.

Example:

Do

```
10 PRINT USING 20: "TOTALS", A, B, C
20 FORM X 9,C 6,SKIP 1,3*N 8.2
```

Instead of

```
10 PRINT USING  20: "TOTALS"
20 FORM X 9,C 6
30 PRINT USING  40: A, B, C
40 FORM 3*N 8.2
```

Constants in variables

Maintain constants in a variable if they are used repeatedly to initialize other variables. This executes somewhat faster than assignment from a constant and uses less storage.

Example:

Do	**Instead of**
`20 LET I1=1`	•
•	•
•	•
`300 LET COUNTER=I1`	`300 LET COUNTER=1`
•	•
•	•
`500 LET SWITCH=I1`	`500 LET SWITCH=1`

BASIC statements and functions (continued)

Array initialization with MAT assignment

Use the MAT assignment statement to initialize an array, since it is nearly as fast as the simple assignment.

Example:

Do	**Instead of**

`10 DIM ARRAY (10)`
`20 MAT ARRAY=(10)`
	`10 DIM ARRAY (10)`
	`20 FOR I=1 TO 10`
	`30 ARRAY(I)=0`
	`40 NEXT I`

Simple subscripts

A performance gain can be realized by not specifying an expression as an array subscript.

Example:

Do	**Instead of**

`X=N+1`
`ARRAY(X)=5`
	`ARRAY (N+1)=5`

Arithmetic guidelines

Consider the arithmetic guidelines provided in the following examples.

Examples:

Do	Instead of
`250 LET B=A*.5`	`250 LET B=A/2`
`500 LET B=A+A`	`500 LET B=A*2`
`650 LET B=A*A*A`	`650 LET B=A**3`

Expressions—avoid repetitive evaluation

Avoid repetitive evaluation of the same expression in a statement. Evaluate the expression once and save the result in a variable for use in subsequent statements.

Example:

Do

```
300 LET A=C*3+D
310 LET X=A+B
320 LET Y=A+E
```

Instead of

```
310 LET X=C*3+D+B
320 LET Y=C*3+D+E
```

System functions

System/23 has 45 preprogrammed system functions. Each of these functions has a specific purpose and was designed to make program development easier and more efficient. Use the system functions whenever possible because they always execute faster than the same capability written in the BASIC language.

The following is a list of some of the very useful system functions with a brief description of their purpose.

Function	Name	Purpose
POS	Position	Locates a string of characters within a second string of characters
SRCH	Search	Searches a one-dimensional array for the location of a specific character string or numeric value
SREP$	String replace	Replaces a substring of characters with a new substring of characters within a larger character string
RPAD$	Pad blanks right	Adds blanks to the right end of a character string
LPAD$	Pad blanks left	Adds blanks to the left end of a character string

RTRM$	Trim blanks right	Removes blanks from the right end of a character string (The V FORM statement specification removes trailing blanks from a character value being input.)
LTRM$	Trim blanks left	Removes blanks from the left end of a character string

You should become familiar with each of the system functions. Refer to the "Reference information" section of this manual for a complete description of each system function.

Appendix C. Performance tips and techniques

Logic control

The sequential execution of a BASIC program can be modified by many of the BASIC statements. Use the following general guidelines when selecting the method of branching for each step of a program.

Labels for branching

Use labels as targets for branching statements to improve the readability of a program.

Branching to labels executes as fast as branching to line numbers. Also, storage is saved if the label is referenced from more than one location in the program.

Example:

```
500 GOTO BEGIN
```

Subroutine use

Use subroutines to handle commonly used portions of a program. Invoke these subroutines using either the GOSUB/RETURN statements or the DEF/FNEND define function statements. The GOSUB/RETURN combination executes faster than the function call. However, the performance of a subroutine is highly dependent upon the BASIC code within the subroutine. Defined functions have specific characteristics not available to the GOSUB/RETURN combination. Review the features of the DEF/FNEND and the GOSUB/RETURN statements in the "Reference information" section of this manual before selecting the subroutine technique to use in a program.

IF statement capabilities

You can achieve improved performance by taking full advantage of the capabilities of the IF statement. By using the logical AND/OR comparison and the THEN/ELSE clause cabability of the IF statement, you can often avoid the need for more IF statements and additional code in a program.

Example:

Do

```
200 IF A=B AND C=D THEN Z=A ELSE Z=B
```

Instead of

```
200 IF A=B THEN GOTO 210
205 GOTO 215
210 IF C=D THEN GOTO 225
215 LET Z=B
220 GOTO 230
225 LET Z=A
230 ...
```

IF statement ordering

Ordering the execution sequence of IF statements can significantly alter the performance of a program. Place the most frequently occuring IF condition at the beginning of a series of IF statements.

Logic control (continued)

Example 1:

A customer order to be read from a data entry file consists of different record types and numerous individual transactions.

Record type	Identification
1	Header
2	Customer name and address
3	Transaction
•	•
•	•
3	Transaction
4	Trailer

Do

```
100 IF RECTYPE$="C" THEN GOTO 3000
110 IF RECTYPE$="A" THEN GOTO 1000
120 IF RECTYPE$="B" THEN GOTO 2000
130 IF RECTYPE$="D" THEN GOTO 4000
```

Instead of

```
100 IF RECTYPE$="A" THEN GOTO 1000
110 IF RECTYPE$="B" THEN GOTO 2000
120 IF RECTYPE$="C" THEN GOTO 3000
130 IF RECTYPE$="D" THEN GOTO 4000
```

Moving the test for record C to the beginning of the list would result in 1800 fewer IF statements executed, assuming 100 groups with an average of 10 transactions per group.

Example 2:

Cascading the IF statements can also improve performance and reduce storage requirements.

Do

```
200 IF A ><1 THEN GOTO NOT1
210 IF B=1 THEN X=0
220 IF B=2 THEN X=1
230 IF B=3 THEN X=2
240 GOTO CONTIN
250 NOT1: IF B=1 THEN X=3
260 IF B=2 THEN X=4
270 IF B=3 THEN X=5
280 CONTIN: ...
```

Instead of

```
200 IF A=1 AND B=1 THEN X=0
210 IF A=1 AND B=2 THEN X=1
220 IF A=1 AND B=3 THEN X=2
230 IF A><1 AND B=1 THEN X=3
240 IF A><1 AND B=2 THEN X=4
250 IF A><1 AND B=3 THEN X=5
```

Logic control (continued)

Loop design

In general, design loops using the FOR/NEXT statements, instead of the IF/GOTO combination of statements.

Example:

```
Do                   Instead of

200 FOR I=1 TO 10    200 I=I+1
 •                   210 IF I=11 THEN GOTO 310
 •                    •
 •                    •
300 NEXT I           300 GOTO 200
```

Tight loops

Always inspect loops for unnecessary code; whenever possible, the code should be removed from the loop. This includes non-executable statements such as FORM (see "Non-executable statements" in this section).

Example:

```
Do                           Instead of

10 LET A=B+1                 10 FOR X=1 to 1000
20 FOR X=1 to 1000           20 LET A=B+1
30 IF D(X)<A THEN D(X)=A 30 IF D(X)<A THEN D(X)=A
40 NEXT X                    40 NEXT X
```

Coding techniques

Non-executable statements

Some required BASIC statements are considered non-executable since they do not functionally alter the program during execution. As these statements are encountered during the execution of a program, the system requires a small amount of time to identify the instruction and proceed to the next sequential statement. The non-executable statements are DIM, DEF/FNEND, FORM, EXIT, and REM. Whenever possible, move these non-executable statements out of loops.

Example:

Do

```
200 DIM A(10)
210 FORM C 5, N 3
220 FOR I=1 to 10
 •
 •
 •
300 NEXT I
```

Instead of

```
200 FOR I=1 to 10
 •
 •
250 DIM A(10)
260 FORM C 5, N 3
 •
300 NEXT I
```

Coding techniques (continued)

Remarks

Comments (REM statements) are considered non-executable. The system requires a small amount of time to identify a REM statement. Place comments on individual instructions using an exclamation point instead of using REM statements whenever possible. Placing comments on individual statements improves performance and also saves storage by eliminating the need for a line number and the REM statement.

Example:

Do

```
100 FOR A=1 to 15 ! Process items
 •
 •
400 NEXT A
```

Instead of

```
100 FOR A=1 to 15
110 REM Process items
 •
 •
490 NEXT A
```

Array redimensioning

The redimensioning of an array is one method of saving storage. In the case where you originally dimension an array to some pre-determined maximum dimensions and find that in the course of running the program you don't need the maximum size, you can redimension downward.

Example:

Do

```
100 DIM A$(100)*20
110 INPUT A  ! Operator types in a number
    of items to be input
120 FOR I = 1 to A
130 INPUT A$(I)
140 NEXT I
 .
 .
 .
190 MAT A$ = A$(A)  ! Redimension down to
    the number of items input
200 CHAIN "NEXTONE", A$, A
```

Instead of

```
100 DIM A$(100)*20
110 INPUT A   ! Operator types in a number
                  of items to be input
120 FOR I = 1 to A
130 INPUT A$(I)
140 NEXT I
 .
 .
 .
190 REM without redimensioning
    you will pass a 100 element array
200 CHAIN "NEXTONE", A$, A
```

Appendix C. Performance tips and techniques

I/O techniques

Buffer space considerations

System/23 does not necessarily do a physical I/O operation each time a READ or WRITE statement is executed. If enough storage is available, System/23 may buffer up to 7.5K bytes of data per file before actually reading from or writing to the diskette. By taking advantage of this buffering, heavily I/O bound programs can be made to run significantly faster.

Points to remember are:

- Sequential vs. relative access of files
  - Sequential access files can be buffered up to 7.5K bytes of data. For relative access files, System/23 tries to keep as many 512 byte buffers as needed to hold one logical record.
  - Use sequential access whenever possible.
- Priority of accessing files
  - When more than one file will be accessed in a program, access the most frequently used file first to ensure that as much buffer space as possible is assigned to this file.
- Need for closing files
  - CLOSE files that are no longer needed. This frees space for buffers.
- Using CHAIN statement
  - Additional space for buffers can be provided by breaking the program into a number of programs by using the CHAIN statement. However, be sure that the benefits are not offset by the length of time it takes to execute the chain.

- Selecting record length
  - System/23 format diskettes have a sector length of 512 bytes. Records that cross sector boundaries require additional physical I/O. To avoid this, choose a record length which, when incremented by one, divides evenly into 512. For example: 63, 127, 511. The extra byte is for the control byte that System/23 attaches to each record in type 04 files.

OPEN statement considerations

An OPEN statement requires many physical I/O operations and is time consuming. The time required can be reduced in the following ways:

- Restrict use of CLOSE and OPEN statements
  - CLOSE a file only if it will not be used again or if storage is a problem. This avoids unnecessary OPENs.

- Position most-used files first
  - Position frequently OPENed files first in the diskette directory. This can be done by creating these files first on empty diskettes before adding additional files.

- Specify drive numbers
  - Specify drive numbers in the OPEN statement whenever possible.

Appendix C. Performance tips and techniques

I/O techniques (continued)

Access time reduction for keyed files

The time required to access keyed files can be reduced in the following ways:

- Use keyed sequential access
  - Whenever possible, use keyed sequential access.
- Specify KW= in OPEN statement
  - For large key files specify "KW=" in the OPEN statement (see "OPEN statement").
- Regenerate key files after update
  - After adding records to the master file, regenerate key files using the Create Index File, Customer Support Function. This places all keys in sorted order within the key file.

General I/O performance guidelines

- Allow sufficient file size
  - System/23 files will be automatically extended when full, but this will slow down any file access. For best performance, whenever possible, create a file as large as will be required.
- Compress files
  - Compress multi-extent files (see "DIR command"). Do this by copying the file to an empty diskette using the Copy Diskette function.
- Multiple rewrites to the same record, see "Programming considerations" under "REWRITE statement."
- Copy diskettes with media errors

  - If a diskette begins to have media errors (see ''DIR command''), transfer all data to another diskette. Do this using the Copy Diskette or Recover Diskette functions.

- Place files for best access
  - When a program will be accessing more than one file, the files should be on separate diskettes or be positioned close together when on a single diskette.

- Select best file format
  - Use BASIC and H-exchange files only to transfer data between System/23 and other systems.
  - Always use System/23 format files for normal processing.

- BASIC language considerations
  - Unformatted I/O is faster than formatted I/O.
  - MAT I/O is faster than scalar processing.

Selection of data file access method

Choosing the proper access method for your data files is one of the more important decisions you must make.

Whether to use the *sequential, relative*, or *keyed* access method depends on your application.

- Accessing individual records
  - *Relative access*. The fastest method of accessing an individual record is directly by means of the relative record number of the desired record.
    For example, in an inventory file it is possible to convert the item number into a record number. Item numbers could be 1 to 1000. Item number 52 would be record 52 in the file. There are more complicated methods for creating a relative record number; however, they are beyond the scope of this manual.
  - *Keyed-access indexing*. This is the next fastest method to access individual records. A pointer to the master file data record is maintained in an index file. This is the most commonly used access method because existing keys such as item numbers can be used.
  - *Sequential access*. Processing a file sequentially to find an individual record is time consuming because the file must be read from the beginning until the proper record is found.

I/O techniques

- Processing sequential files
  - If an *entire file* is to be processed from beginning to end, sequential access is the fastest method.
  - The fastest method to process a file sequentially is to sort the master file into the desired order before processing.
  - To process a RELATIVE file sequentially starting at a specified record number, first OPEN the file RELATIVE, and then execute a RESTORE #X, REC=A statement. Subsequent READ statements without a REC= clause will read each record sequentially from the file.

- Processing keyed files
  - If a file is to be processed SEQUENTIAL in some cases and RELATIVE in others, it may be more appropriate to create an index (key) file. The system can then access the master file (1) SEQUENTIAL by accessing the index file or (2) RELATIVE by providing a key to the index file.

I/O techniques (continued)

Main storage index area for keyed access method

Access to a master file record using an index (key) file can be improved substanially if you maintain an index area in main storage that points to the index (key) file. To do this, use the KW= parameter, which is included in the OPEN statement.

Example:

```
30 OPEN #1:"NAME=TAXES,KFNAME=TAXKEY,KW=50",
INTERNAL,INPUT,KEYED
```

In the preceding statement , 50 bytes of main storage have been allocated for index file pointers.

Performance can be substantially improved for random key access to a file when an optimum KW parameter is assigned. Refer to the "OPEN statement" section of this manual for a complete description of the KW parameter and how to calculate the optimum KW value.

Index file sorting

Many applications, such as inventory, make use of an index file with pointers that allow fast access to desired records. If the index file is sorted, access to a master record will be faster than if the index file is not sorted. The index file for a master file is automatically placed in sorted order when it is initially created by the Create Index File function. See *Customer Support Functions*, Volume II.

As new items are added to the master file, the item number key (item number is specified as the key) is added to the end of the index file. Depending on the activity of adding and deleting records, the index file should be periodically *recreated* so that the new index record is placed in its proper location and the unwanted index records are deleted.

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