NIXDORF
COMPUTER

Nixdorf 8810

GW BASIC

Edition: 01.10.85 Order no: 16128.00.6.93

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NIXDORF COMPUTER

C O N T E N T S

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8810 GW BASIC

Modifications sheet

This sheet lists all modifications made to this module since the appearance of the first edition. It should be replaced by the sheet provided whenever further modifications are announced.

First edition 10/85 Rel. 2.01

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8810 GW BASIC

Errors/suggestions for improvement

If you have noticed any errors while using this section of the system's literature, or should you have suggestions for improvement of the module, please send your written comments to the following address:

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1 Introduction

In 1975, Microsoft wrote the first BASIC interpreter for microcomputers. Today, Microsoft BASIC has well over 1,000,000 installations and is used in many operating environments. It's the BASIC you will find on all of the most popular microcomputers. Many users, manufacturers, and software vendors have written application programs in Microsoft(R) BASIC.

The BASIC interpreter is a general-purpose programming language: it is effective for many applications, including business, science, games, and education. It is interactive; that is, without writing a program, a user can perform processes, calculations, and program testing.

Microsoft GW(tm)-BASIC is the most extensive implementation of Microsoft BASIC available for microprocessors. It meets the requirements for the ANSI subset standard for BASIC, and supports many features rarely found in other BASIC interpreters. In addition, the Microsoft GW-BASIC Interpreter has sophisticated screen handling, graphics, and structured programming features that are especially suited for application development.

1.1 Overview

GW-BASIC includes several features not found in other BASICs, and has been designed to take advantage of the MS(tm)-DOS environment to enhance programming power.

Some of the new features and improvements over GW-BASIC are:

* Re-direction of Standard Input (INPUT, LINE INPUT) and Standard Output (PRINT)

* Character Device support which allows BASIC to initialize and communicate with user-installed devices

* Improved Disk I/O facilities for handling larger files

* SHELL which allows COMMAND or Child processes to run without having to leave BASIC

* Multi level directories for better disk organization

* Directory management (MKDIR/CHDIR/RMDIR)

* Improved Graphics: Line Clipping, VIEW, WINDOW

* Screen Editor enhancements including text window support

* Additional Event Trapping: PLAY, TIMER

* User definable Keyboard trapping

* More precise error reporting with the new system functions: ERDEV and ERDEV$

* Double Precision Transcendentals (optional with the /D switch)

* More precise control of BASIC's memory allocation for user routines with the /M: switch

1.2 Syntax Notation

When commands are discussed in this document, the following notation will be followed:

[ ] Square brackets indicate that the enclosed entry is optional.

<> Angle brackets indicate user-entered data. When the angle brackets enclose lowercase text, the user must type in an entry defined by the text; for example, <filename>. When the angle brackets enclose uppercase text, the user must press the key named by the text; for example, <RETURN>.

{ } Braces indicate that the user has a choice between two or more entries. At least one of the entries enclosed in braces must be chosen unless the entries are also enclosed in square brackets.

| Vertical bars separate choices within braces. At least one of the entries separated by bars must be chosen unless the entries are also enclosed in square brackets.

times as needed or desired.

CAPS Capital letters indicate portions of statements or commands that must be entered exactly as shown.

All other punctuation, such as commas, colons, slash marks, and equal signs, must be entered exactly as shown.

Examples

Command Line Explanation

SAVE <filespec> [{A|P}]

These two entries are optional as indicated by the square brackets. They also must be typed in as shown. The braces indicate an either/or choice.

The lowercase filespec means you must supply the file specification (disk drive, filename and extension).

Capital letters indicate that the word must be entered exactly as shown.

1.3 Resources For Learning BASIC

This manual provides complete instructions for using Microsoft BASIC. However, no training material for BASIC programming has been provided. If you are new to BASIC or need help in learning programming, we suggest you read one of the following:

Dwyer, Thomas A. and Critchfield, Margot. BASIC and the Personal Computer. Reading, Mass.: Addison-Wesley Publishing Co., 1978.

Albrecht, Robert L., Finkel, LeRoy, and Brown, Jerry. BASIC. New York: Wiley Interscience, 2nd ed., 1978.

Daubach, Guenther Microsoft Basic 80; for Personal Computers with the CP/M operating system. Vaterstetten: IWT Publishing Co., 1984.

Billings, Karen and Moursund, David. Are You Computer Literate? Beaverton, Oregon: Dilithium Press, 1979.

Coan, James. Basic BASIC. Rochelle Park, N.J.: Hayden Book Company, 1978.

2 Using the GW-BASIC Interpreter

2.1 Invoking BASIC

To begin operating the GW-BASIC Interpreter, load the MS-DOS operating system and then enter:

GWBASIC

To begin operating a specific program as soon as BASIC has started, load the operating system and enter:

GWBASIC <filespec>

where <filespec> is a filename preceeded by an optional device designator, and followed by an optional extension name.

For example, to start the program FILE.BAS which is on disk drive A:, enter:

GWBASIC A:FILE.BAS

2.2 Command Line Option Switches

The BASIC operating environment may be altered somewhat by specifying option switches following BASIC on the command line. The format of BASIC's command line is:

GW-BASIC [<stdin]
[>stdout]
[<filespec>]
[/C:<buffer size>]
[/D]
[/F:<number of files>]
[/I]
[/M:[<highest memory location>] [,<maximum block size>]]
[/S:<lrecl>]

WHERE:

<stdin
GW-BASIC input is redirected from the file specified by stdin. When present, this syntax must appear before any switches. Note that the less-than character "<" is literally that character, and not an angle bracket indicating a required argument.

>stdout
GW-BASIC output is redirected to the file specified by stdout. When present, this syntax must appear before any switches. If two greater-than signs appear (">>"), the output is appended to an existing output file. If an existing file is to be written to, this is the way to prevent that file from being overwritten. Note that the greater-than character ">" is literally that character, and not an angle bracket indicating a required argument.

<filespec>
This is the file specification of a BASIC program. If <filespec> is present, BASIC proceeds as if a RUN <filespec> command were given after initialization is complete. This allows BASIC programs to be initiated by a batch file by putting this form of the command line in an AUTOEXEC.BAT file. Programs run in this manner will need to exit via the SYSTEM statement in order to allow the next command from the AUTOEXEC.BAT file to be executed.

/F:<number of files>
This switch is ignored unless the /I switch is specified on the command line. Please refer to the /I switch documentation below.

If this switch and the /I switch are present, the maximum number of files that may be open simultaneously during the execution of a BASIC program is set to <number of files>. Each file requires 62 bytes for the File Control Block (FCB) plus 128 bytes for the data buffer. The data buffer size may be altered via the /S: option switch. If the /F: option is omitted, the number of files is set to 3.

The number of open files that MS-DOS supports depends upon the value of the FILES= parameter in the CONFIG.SYS file. It is recommended that FILES=10 for BASIC. Keep in mind that the first 3 are taken by Stdin, Stdout, Stderr, Stdaux, and Stdprn. One additional handle is needed by BASIC for LOAD, SAVE, CHAIN, NAME, and MERGE. This leaves 6 for BASIC File I/O, thus /F:6 is the maximum supported by MS-DOS when FILES=10 appears in the CONFIG.SYS file.

Attempting to OPEN a file after all the file handles have been exhausted will result in a "Too many files" error.

/S:<lrecl>
This switch is ignored unless the /I switch is specified on the command line. Please refer to the /I switch documentation below.

If this switch and the /I switch are present, then the maximum record size allowed for use with random files is set to <lrecl>. NOTE: the record size option to the OPEN statement cannot exceed this value. If the /S: option is omitted, the record size defaults to 128 bytes.

/C:<buffer size>
If present, this switch controls RS232 Communications. If RS232 cards are present, /C:0 disables RS232 support. Any subsequent I/O attempts will result in a "Device Unavailable" error. Specifying /C:<n> allocates space for communications buffers. The amount of space allocated is dependent on the machine-specific portion of GW-BASIC.

/D
If present, this switch causes the Double Precision Transcendental math package to remain resident. If omitted, this package is discarded and the space is freed for program use.

/I
GW-BASIC is able to dynamically allocate space required to support file operations. For this reason, GW-BASIC does not need to support the /S and /F switches. However, certain applications have been written in such a manner that certain BASIC internal data structures must be static. In order to provide compatibility with these BASIC programs, GW-BASIC will statically allocate space required for file operations based on the /S and /F switches when the /I switch is specified.

/M:[<highest memory location>][,<max block size>]
When present, this switch sets the highest memory location that will be used by BASIC. BASIC will attempt to allocate 64k of memory for the data and stack segment. If machine language subroutines are to be used with BASIC programs, use the /M: switch to set the highest location that BASIC can use. When omitted or 0, BASIC attempts to allocate all it can up to a maximum of 65536 bytes.

If you intend to load things above the highest location that BASIC can use, then use the optional parameter <maximum block size> to preserve space for them. This is necessary if you intend to use the SHELL statement (see Section 7.135). Failure to do so will result in COMMAND being loaded on top of your routines when a SHELL statement is executed.

<maximum block size> must be in paragraphs (byte multiples of 16). When omitted, &H1000 (4096) is assumed. This allocates 65536 bytes (65536= 4096 x 16) for BASIC's data and stack segment. For example, if you wanted 65536 bytes for BASIC and 512 bytes for machine language subroutines, then use /M:,&H1010 (4096 paragraphs for BASIC + 16 paragraphs for your routines).

This option can also be used to shrink the BASIC block in order to free more memory for shelling other programs. /M:,2048 allocates 32768 bytes for data and stack. /M:32000,2048 allocates 32768 bytes maximum, but BASIC will only use the lower 32000. This leaves 768 bytes for the user.

USING THE GW-BASIC INTERPRETER

NOTE <number of files>, <lrecl>, <buffer size>, <highest memory location>, and <maximum block size> are numbers that may be decimal, octal (preceeded by &O), or hexadecimal (preceeded by &H).

Example

GWBASIC PAYROLL	Use 64k of memory and 3 files, load and execute PAYROLL.BAS.
GWBASIC INVENT/I/F:6	Use 64k of memory and 6 files, load and execute INVENT.BAS.
GWBASIC /C:0/M:32768	Disable RS232 support and use only the first 32k of memory. The memory above that is free for the user.
GWBASIC /I/F:4/S:512	Use 4 files and allow a maximum record length of 512 bytes.
GWBASIC TTY/C:512	Use 64k of memory and 3 files. Allocate 512 bytes to RS232 receive buffers and 128 bytes to transmit buffers, load and execute TTY.BAS.

2.3 Modes Of Operation

The Microsoft GW-BASIC Interpreter may be used in either of two modes: direct mode or indirect mode.

In direct mode, statements and commands are executed as they are entered. They are not preceded by line numbers. After each direct statement followed by a carriage return, the screen will display the "Ok" prompt. Results of arithmetic and logical operations may be displayed immediately and stored for later use, but the instructions themselves are lost after execution. Direct mode is useful for debugging and for using the GW-BASIC Interpreter as a calculator for quick computations that do not require a complete program.

Indirect mode is used for entering programs. Program lines are preceded by line numbers and may later be stored in memory. The program stored in memory is executed by entering the RUN command.

2.4 Line Format

Microsoft GW-BASIC program lines have the following format (square brackets indicate optional input):

<nnnnn><BASIC statement> [:BASIC statement...] <carriage return>

More than one GW-BASIC statement may be placed on a line, but each must be separated from the last by a colon.

A Microsoft GW-BASIC program line always begins with a line number and ends with a carriage return. Line numbers indicate the order in which the program lines are stored in memory. Line numbers are also used as references in branching and editing. Line numbers must be in the range 0 to 65529.

A line may contain a maximum of 255 characters.

With the interpreter, you can extend a logical line over more than one physical line by entering a <linefeed>. <linefeed> lets you continue typing a logical line on the next physical line without entering a <carriage return>. Alternatively, you may type up to 255 characters on a logical line without issuing either a line feed or a carriage return; the text is wrapped and continues on the next physical line.

A period (.) may be used in EDIT, LIST, AUTO, and DELETE commands to refer to the current line.

2.5 Active And Visual (Display) Pages

The size of these pages is set by the SCREEN statement. (See SCREEN Statement, Section 7.132)

3 LEARNING THE LANGUAGE

Like any language, BASIC has an alphabet and common phrases. This chapter presents the BASIC character set, and the rules for the constants, variables, and expressions that the programming language uses.

3.1 Character Set

The Microsoft GW-BASIC character set consists of alphabetic characters, numeric characters, and special characters.

The alphabetic characters in GW-BASIC are the uppercase and lowercase letters of the English alphabet.

The GW-BASIC numeric characters are the digits 0 through 9. The alphabetic characters A,B,C,D,E, and F may be used as part of hexadecimal numbers.

3.1.1 Special Characters

The following special characters and terminal keys are recognized by GW-BASIC:

Character	Action
	Blank
=	Equals sign or assignment symbol
+	Plus sign
-	Minus sign
*	Asterisk or multiplication symbol
/	Slash or division symbol
^	Up arrow or exponentiation symbol
(	Left parenthesis
)	Right parenthesis
%	Percent
#	Number (or pound) sign
$	Dollar sign
!	Exclamation point
[	Left bracket
]	Right bracket
,	Comma
'	Single quotation mark (apostrophe)
;	Semicolon
:	Colon
&	Ampersand
?	Question mark
<	Less than
>	Greater than
\	Backslash or integer division symbol
@	At sign
_	Underscore
<rubout>	Deletes last character typed.
<escape>	Escapes edit mode subcommands.
<tab>	Moves print position to next tab stop. Tab stops are set every eight columns.
<linefeed>	Moves to next physical line.
<return>	Terminates input of a line.

3.1.2 Control Characters

Microsoft GW-BASIC supports the following control characters:

Control Character	Action
Control-A	Enters edit mode on the line being typed.
Control-B	Moves cursor to previous word.
Control-C	With the interpreter, interrupts program execution and returns to BASIC command
Control-E	Clears to end of line.
Control-F	Moves cursor to the next word.
Control-G	Sounds the speaker.
Control-H	Backspaces. Deletes the last character typed.
Control-I	Tabs to the next tab stop. Tab stops are set every eight columns.
Control-K	Sends cursor to home location.
Control-L	Clears the screen.
Control-N	Moves cursor to the end of the line.
Control-O	Halts program output while execution continues. A second Control-O resumes output.
Control-Q	Resumes program execution after a Control-S.
Control-R	Toggles the insert and typeover modes.
Control-S	Suspends program execution.

3.2 Constants

Constants are the values that cannot be changed during execution. There are two types of constants: string and numeric.

3.2.1 String and Numeric Constants

A string constant is a sequence of up to 255 alphanumeric and specified control characters enclosed in double quotation marks.

Examples:

"HELLO"
"$25,000.00"
"Number of Employees"

Numeric constants are positive or negative numbers. Microsoft GW-BASIC numeric constants cannot contain commas. There are five types of numeric constants:

1. Integer constants — Whole numbers between -32768 and 32767. Integer constants do not contain decimal points.

2. Fixed-point constants — Positive or negative real numbers, i.e., numbers that contain decimal points.

3. Floating-point — Positive or negative numbers represented in exponential form (similar to scientific notation). A floating-point constant consists of an optionally signed integer or fixed-point number (the mantissa) followed by the letter E and an optionally signed integer (the exponent). The allowable range for floating-point constants is 10-38 to 10+38.

Examples:

235.988E-7 = .0000235988
2359E6 = 2359000000

(Double precision floating-point constants are denoted by the letter D instead of E.)

4. Hex constants — Hexadecimal numbers, denoted by the prefix &H. Hex constants may be no greater than decimal 64K.

Examples:

&H76
&H32F

5. Octal constants — Octal numbers, denoted by the prefix &0 or &. Octal constants may not exceed decimal 64K.

Examples:

```
&0347
&1234
```

3.2.2 Single/Double Precision Numeric Constants

Numeric constants may be either single precision or double precision numbers. Single precision numeric constants are stored with 7 digits of precision and printed with up to 6 digits of precision. Double precision numeric constants are stored with 16 digits of precision and printed with up to 16 digits.

A single precision constant is any numeric constant that has one of the following characteristics:

1. Seven or fewer digits

2. Exponential form using E

3. A trailing exclamation point (!)

Examples:

```
 46.8
-1.09E-06
 3489.0
 22.5!
```

A double precision constant is any numeric constant that has one of these characteristics:

1. Eight or more digits

2. Exponential form using D

3. A trailing number sign (#)

Examples:

```
 345692811
-1.09432D-06
 3489.0#
 7654321.1234
```


3.3 Variables

Variables are names used to represent values used in a GW-BASIC program. The value of a variable may be assigned explicitly by the programmer, or it may be assigned as the result of calculations in the program. Before a variable is assigned a value, its value is assumed to be zero (or null for a string variable).

3.3.1 Variable Names and Declaration Characters

Microsoft GW-BASIC variable names may be any length. Up to 40 characters are significant. Variable names can contain letters, numbers, and the decimal point. However, the first character must be a letter. Special type declaration characters (listed below) are also allowed.

A variable name may not be a reserved word, but embedded reserved words are allowed, with one exception: no variable may start with the letters USR. For example, the variable USRNAM$ will generate a syntax error. Reserved words include all Microsoft GW-BASIC commands, statements, function names, and operator names. If a variable begins with FN, it is assumed to be a call to a user-defined function.

Variables may represent either a numeric value or a string. String variable names are written with a dollar sign ($) as the last character. For example: A$ = "SALES REPORT". The dollar sign is a variable type declaration character; that is, it "declares" that the variable will represent a string.

Numeric variable names may be declared as integer, single precision, or double precision values. The type declaration characters for these variable names are as follows:

% Integer variable

! Single precision variable

Double precision variable

The default type for a variable name is single precision. However, if a number specified in a program has too many significant digits to be represented by a single precision number, it will be represented as a double precision number, and the " " which signifies double precision will follow the number in the program listing.

Integer variables produce the fastest and most compact object code. For example, the following program executes approximately 30 times faster when the loop control variable "I" is replaced with "I%", or when I is declared an integer variable with DEFINT.

```
100 FOR I=1 TO 10
120   A(I)=0
140 NEXT I
```

Examples of Microsoft GW-BASIC variable names:

PI#	Declares a double precision value.
MINIMUM!	Declares a single precision value.
LIMIT%	Declares an integer value.
N$	Declares a string value.
ABC	Represents a single precision value.

The default variable type may be selectively changed by using the GW-BASIC statements DEFINT, DEFSTR, DEFDBL, and DEFSNG. These statements are described in detail in Section 7.31.

3.3.2 Array Variables

An array is a group or table of values referenced by the same variable name. Each element in an array is referenced by an array variable that is subscripted with an integer or an integer expression. An array variable name has as many subscripts as there are dimensions in the array. For example V(10) would reference a value in a one-dimension array, T(1,4) would reference a value in a two-dimension array, and so on. The maximum number of dimensions for an array is 255. The maximum number of elements per dimension is 32,767. The maximum amount of space that may be taken for an array is 64K.

3.3.3 Space Requirements

The following list gives only the number of bytes occupied by the values represented by the variable names. Additional requirements may vary according to implementation.

Variables	Type	Bytes
	Integer	2
	Single precision	4
	Double precision	8
	String	3

Arrays	Type	Bytes
	Integer	2 per element
	Single precision	4 per element
	Double precision	8 per element
	String	3 per element

3.4 Expressions And Operators

An expression may be a string or numeric constant, a variable, or a combination of constants and variables with operators. An expression always produces a single value.

Operators perform mathematical or logical operations on values. GW-BASIC operators may be divided into three categories:

1. Arithmetic
2. Relational
3. Logical

Each category is described in the following sections.

3.4.1 Precedence of Operations

The GW-BASIC operators have an order of precedence; that is, when several operations take place within the same program statement, certain kinds of operations will be performed before others. If the operations are of the same level of precedence, the first to be executed will be the leftmost, and the last, the rightmost. The following is the order in which operations are executed.

1. Exponentiation
2. Negation
3. Multiplication & Division
4. Integer Division
5. Modulus Arithmetic
6. Addition & Subtraction
7. Relational Operators
8. NOT
9. AND
10. OR & XOR
11. EQV
12. IMP

3

3.4.2 Arithmetic Operators

The arithmetic operators, in order of evaluation, are:

Operator	Operation	Sample Expression
^	Exponentiation	X^Y
-	Negation	-X
*, /	Multiplication, Floating-point Division	X*Y X/Y
\	Integer division	12\6=2
MOD	Modulus arithmetic	10 MOD 4=2 (10/4=2 with remainder 2)
+, -	Addition, Subtraction	X+Y

You can change the order of evaluation by using parentheses. Operations within parentheses are performed first. Inside parentheses, the usual order of operations is maintained.

The following list gives some sample algebraic expressions and their Microsoft GW-BASIC counterparts.

Algebraic Expression	BASIC Expression
$X+2Y$	X+Y*2
$X-\frac{Y}{Z}$	X-Y/Z
$\frac{XY}{Z}$	X*Y/Z
$\frac{X+Y}{Z}$	(X+Y)/Z
$(X^{2})^{Y}$	(X^2)^Y
$X^{Y^{Z}}$	X^(Y^Z)
$X(-Y)$	X*(-Y) Two consecutive operators must be separated by parentheses.

3

3.4.2.1 Integer Division and Modulus Arithmetic

In addition to the six standard operators (addition, subtraction, multiplication, division, negation, and exponentiation), GW-BASIC supports integer division and modulus arithmetic.

Integer division is denoted by the backslash (\). The operands are rounded to integers (must be in the range -32768 to 32767) before the division is performed, and the quotient is truncated to an integer.

Examples:

```
100 LET DIV1 = 10\4
200 LET DIV2 = 25.68\6.99
300 PRINT DIV1, DIV2
will yield
2             3
```

Modulus arithmetic is denoted by the operator MOD. Modulus arithmetic yields the integer value that is the remainder of an integer division.

Examples:

```
10 PRINT 10.4 MOD 4, 25.68 MOD 6.99
```

will yield

```
2             5
```

because (10/4=2 with a remainder 2) and (26/7=3 with a remainder 5).

3.4.2.2 Overflow and Division by Zero

If division by zero is encountered during the evaluation of an expression, a "Division by zero" error message is displayed. Machine infinity (the largest number that can be represented in floating-point format) with the sign of the numerator is supplied as the result of the division, and execution continues. If the evaluation of an exponentiation operator results in zero being raised to a negative power, the "Division by zero" error message is displayed, positive machine infinity is supplied as the result of the exponentiation, and execution continues.

If overflow occurs, the interpreter displays an "Overflow" error message, supplies machine infinity with the algebraically correct sign as the result, and continues execution.

3.4.3 Relational Operators

Relational operators are used to compare two values. The result of the comparison is either "true" (-1) or "false" (0). This result may then be used to make a decision regarding program flow. (See IF Statement, Section 7.57.)

The relational operators are:

Operator	Relation Tested	Example
=	Equality	X=Y
<>	Inequality	X<>Y
<	Less than	X<Y
>	Greater than	X>Y
<=	Less than or equal to	X<=Y
>=	Greater than or equal to	X>=Y

(The equal sign is also used to assign a value to a variable. See the LET statement, Section 7.70.)

When arithmetic and relational operators are combined in one expression, the arithmetic is always performed first. For example, the expression

```
X+Y<(T-1)/Z
```

is true if the value of X plus Y is less than the value of T-1 divided by Z.

More examples:

```
IF SIN(X)<0 GOTO 1000
IF I MOD J<>0 THEN K=K+1
```


3.4.4 Logical Operators

The logical operator performs bit-by-bit calculation and returns a result which is either "true" (not zero) or "false" (zero). In an expression, logical operations are performed after arithmetic and relational operations. The outcome of a logical operation is determined as shown in Table 3-1. The operators are listed in order of precedence.

Table 3-1. GW-BASIC Relational Operators Truth Table

Operation	Value	Value	Result
NOT			
	X		NOT X
	T		F
	F		T
AND			
	X	Y	X AND Y
	T	T	T
	T	F	F
	F	T	F
	F	F	F
OR			
	X	Y	X OR Y
	T	T	T
	T	F	T
	F	T	T
	F	F	F
XOR			
	X	Y	X XOR Y
	T	T	F
	T	F	T
	F	T	T
	F	F	F
EQV			
	X	Y	X EQV Y
	T	T	T
	T	F	F
	F	T	F
	F	F	T
IMP			
	X	Y	X IMP Y
	T	T	T
	T	F	F
	F	T	T
	F	F	T

3

Just as the relational operators can be used to make decisions regarding program flow, logical operators can connect two or more relations and return a true or false value to be used in a decision (see IF Statements, Section 7.57).

Example:

```
IF D<200 AND F<4 THEN 80
IF I>10 OR K<0 THEN 50

IF NOT P THEN 100
```

Logical operators work by converting their operands to 16-bit, signed, two's complement integers in the range -32768 to 32767. (If the operands are not in this range, an error results.) If both operands are supplied as 0 or -1, logical operators return 0 or -1. The given operation is performed on these integers bit-by-bit; i.e., each bit of the result is determined by the corresponding bits in the two operands.

Thus, it is possible to use logical operators to test bytes for a particular bit pattern. For instance, the AND operator may be used to "mask" all but one of the bits of a status byte at a machine I/O port. The OR operator may be used to "merge" two bytes to create a particular binary value. The following examples, all using decimal numbers, demonstrate how the logical operators work.

63 AND 16 = 16	63 = binary 111111 and 16 = binary 10000, so 63 AND 16 = 16.
15 AND 14 = 14	15 = binary 1111 and 14 = binary 1110, so 15 AND 14 = 14 (binary 1110).
-1 AND 8 = 8	-1 = binary 1111111111111111 and 8 = binary 1000, so -1 AND 8 = 8.
4 OR 2 = 6	4 = binary 100 and 2 = binary 10, so 4 OR 2 = 6 (binary 110).
10 OR 10 = 10	10 = binary 1010, so 1010 OR 1010 = 1010 (decimal 10).

-1 OR -2 = -1	-1 = binary 1111111111111111 and -2 = binary 1111111111111110, so -1 OR -2 = -1. The bit complement of sixteen zeros is sixteen ones, which is the two's complement representation of -1.
NOT X = -(X+1)	The two's complement of any integer is the bit complement plus one.

3.4.5 String Operators

Strings may be concatenated by using the plus sign (+). For example:

```
10 A$="FILE" : B$="NAME"
20 PRINT A$+B$
30 PRINT "NEW "+A$+B$
```

will yield

```
FILENAME
NEW FILENAME
```

Strings may be compared using the same relational operators that are used with numbers:

```
=    <>    <    >    <=    >=
```

String comparisons are made by taking one character at a time from each string and comparing the ASCII codes. If all the ASCII codes are the same, the strings are equal. If the ASCII codes differ, the lower code number precedes the higher. If during string comparison the end of one string is reached, the shorter string is said to be smaller. Leading and trailing blanks are significant.

For example:

```
"AA"          is less than      "AB"
"FILENAME"    is equal to       "FILENAME"
"X&"          is greater than   "X#"
  (because # comes before &)
"CL "         is greater than   "CL"
  (because of the trailing space)
"kg"          is greater than   "KG"
"SMYTH"       is less than      "SMYTHE"
B$            is less than      "9/12/78"
               (where B$="8/12/78")
```

Thus, string comparisons can be used to test string values or to alphabetize strings. All string constants used in comparison expressions must be enclosed in quotation marks.

3.5 Type Conversion

When necessary, Microsoft GW-BASIC will convert a numeric constant from one type to another. The following rules and examples apply to conversions.

1. If a numeric variable of one type is set equal to a numeric constant of a different type, the number will be stored as the type declared in the variable name.

Example:

```
10 PERCENT%=23.42
20 PRINT PERCENT%
```

will yield

```
23
```

2. During expression evaluation, all of the operands in an arithmetic or relational operation are converted to the same degree of precision as that of the most precise operand. Also, the result of an arithmetic operation is returned to this degree of precision.

Examples:

```
10 DEDUCTION#=6#/7
20 PRINT DEDUCTION#
```

will yield

0.8751428571428571

The arithmetic was performed in double precision and the result was returned in DEDUCTION# as a double precision value.

```
10 DEDUCTION=6#/7
20 PRINT DEDUCTION
```

will yield

0.857143

The arithmetic was performed in double precision, and the result is rounded to single precision and returned to DEDUCTION (single precision variable), and printed.

3. Logical operators (see Section 3.4.4) convert their operands to integers and return an integer result. Operands must be in the range -32768 to 32767 or an "Overflow" error occurs.

4. When a floating-point value is converted to an integer, the fractional portion is rounded.

Example:

```
10 CASH%=55.88
20 PRINT CASH%
```

will yield

56

5. If a double precision variable is assigned a single precision value, only the first seven digits (rounded) of the converted number will be valid. This is because only seven digits of accuracy were supplied with the single precision value. The absolute value of the difference between the printed double precision number and the original single precision value will be less than 6.3E-8 times the original single precision value.

Example:

```
10 A=2.04
20 B#=A
30 PRINT A;B#
```

will yield

```
2.04  2.039999961853027
```

3.6 Functions

GW-BASIC incorporates two kinds of functions: intrinsic and user-defined.

3.6.1 Intrinsic Functions

When a function is used in an expression, it calls a predetermined operation that is to be performed on an operand. Microsoft GW-BASIC has functional operators that reside in the system, such as SQR (square root) or SIN (sine), and these resident functions are called "intrinsic functions".

3.6.2 User-Defined Functions

Microsoft GW-BASIC also allows "user-defined" functions that are written by the programmer. See DEF FN Statement, Section 7.30.

4 WRITING PROGRAMS USING THE GW-BASIC EDITOR

GW-BASIC provides two ways to enter and edit text: you can issue an EDIT command to place you in edit mode or use the full screen editor.

4.1 EDIT Command

The EDIT command places the cursor on a specified line so that changes can be made to the line. See EDIT command, Section 7.37.

4.2 Full Screen Editor

The full screen editor gives you immediate visual feedback, so that program text is entered in a "what you see is what you get" manner. If the user has a program listing on the screen, the cursor can be moved to a program line, the line edited, and the change entered by pressing the return key. This time-saving capability is made possible by special keys for cursor movement, character insertion and deletion, and line or screen erasure. Specific functions and key assignments are discussed in the following sections.

With the full screen editor, you can move quickly around the screen, making corrections where necessary. The changes are entered by placing the cursor on the changed line and pressing <RETURN>.

When input processes are directed from the screen, the user may use the full-screen editor features in responding to INPUT and LINE INPUT statements.

4.2.1 Writing Programs

You are using the full screen editor any time between the interpreter's "OK" prompt and the execution of a RUN command. Any line of text that is entered is processed by the editor. Any line of text that begins with a number is considered a program statement.

It is possible to extend a logical line over more than one physical line by continuing typing beyond the last column of the screen. The editor wraps the logical line so that it continues on the next physical line. A carriage return signals the end of the logical line; when a carriage return is entered, the entire logical line is passed to GW-BASIC. Up to 255 characters may be present in one logical line.

Program statements are processed by the editor in one of the following ways:

1. A new line is added to the program. This occurs if the line number is valid (0 through 65529) and at least one non-blank character follows the line number.

2. An existing line is modified. This occurs if the line number matches that of an existing line in the program. The existing line is replaced with the text of the new line.

3. An existing line is deleted. This occurs if the line contains only the line number, and the number matches that of an existing line.

4. The statements are passed to the command scanner for interpretation (i.e., the statement is executed).

5. An error is produced.

If an attempt is made to delete a non-existent line, an "Undefined line" error message is displayed.

If program memory is exhausted, and a line is added to the program, an "Out of memory" error message is displayed, and the line is not added.

More than one statement may be placed on a line. If this is done, the statements must be separated by a colon (:). The colon need not be surrounded by spaces.

4.2.2 Editing Programs

Use the LIST command to display an entire program or range of lines on the screen so that they can be edited with the full screen editor. Text can then be modified by moving the cursor to the place where the change is needed and then performing one of the following actions:

1. Typing over existing characters
2. Deleting characters to the right of the cursor
3. Deleting characters to the left of the cursor
4. Inserting characters
5. Appending characters to the end of the logical line

These actions are performed by special keys assigned to the various full screen editor functions (see the next section).

Changes to a line are recorded when a carriage return is entered while the cursor is somewhere on that line. The carriage return enters all changes for that logical line, and, up to the 255 character line limitation, no matter how many physical lines are included and no matter where the cursor is located on the line.

4.2.3 Control Characters

Table 4-1 lists the hexadecimal codes for the GW-BASIC control characters and summarizes their functions. The Control-key sequence normally assigned to each function is also listed.

Individual control functions are described following Table 4-1.

Table 4-1. GW-BASIC Control Functions.

Hex. Code	Control Key	Function
01	Ctrl-A	Enter edit mode
02	Ctrl-B	Move cursor to start of previous word
03	Ctrl-C	Break
04	Ctrl-D	Ignored
05	Ctrl-E	Truncate line (clear text to end of logical line)
06	Ctrl-F	Move cursor to start of next word
07	Ctrl-G	Beep
08	Ctrl-H	Backspace, deleting characters passed over
09	Ctrl-I	Tab (8 spaces)
0A	Ctrl-J	Linefeed
0B	Ctrl-K	Move cursor to home position
0C	Ctrl-L	Clear window
0D	Ctrl-M	Carriage return (enter current logical line)
0E	Ctrl-N	Append to end of line
0F	Ctrl-O	Suspend or restart program output
10	Ctrl-P	Ignored
11	Ctrl-Q	Restart suspended program
12	Ctrl-R	Toggle insert/typeover mode
13	Ctrl-S	Suspend program
17	Ctrl-W	Delete word
1B	Ctrl-	clear line
1C	→	Cursor right
1D	←	Cursor left
1E	↑	Cursor up
1F	↓	Cursor down (underscore)
7F	DEL	Delete character at cursor

4.2.4 Logical line Definition with INPUT

Normally, a logical line consists of all the characters on each of the physical lines that make up the logical line. During execution of an INPUT or LINE INPUT statement, however, this definition is modified slightly to allow for forms input. When either of these statements is executed, the logical line is restricted to characters actually typed or passed over by the cursor. The insert and delete modes move only characters that are within that logical line, and delete mode will decrement the size of the line.

Insert mode increments the logical line except when the characters moved will write over non-blank characters that are on the same physical line but not part of the logical line. In this case, the non-blank characters not part of the logical line are preserved and the characters at the end of the logical line are thrown out. This preserves labels that existed prior to the INPUT statement.

4.2.5 Editing Lines with Syntax Errors

When a syntax error is encountered during program execution, GW-BASIC prints the line containing the error and enters direct mode. You can correct the error, enter the change, and reexecute the program. When a line is modified, all files are closed, and all variables are lost. Thus, if the user wishes to examine the contents of variables just before the syntax error was encountered, the user should print the values before modifying the program line. Alternative ways to get to direct mode without erasing variable values or closing files are the STOP and END commands.

5 WORKING WITH FILES AND DEVICES

This chapter discusses the way files and devices are used and addressed in GW-BASIC, and the way information is input and output through the system.

5.1 Default Device

When a filespec is given (in commands or statements such as FILES, OPEN, KILL), the default (current) disk drive is the one that was the default in MS-DOS before GW-BASIC was invoked.

5.2 Device-Independent Input/Output

Microsoft GW-BASIC provides device-independent input/output that permits flexible approaches to data processing. Using device independent I/O means that the syntax for access is the same for any device.

The following statements, commands, and functions support device-independent I/O (see individual descriptions in Chapter 7):

```
BLOAD          LOF
BSAVE          MERGE
CHAIN          OPEN
CLOSE          POS
EOF            PRINT
GET            PRINT USING
INPUT          PUT
INPUT$         RUN
LINE INPUT     SAVE
LIST           WIDTH
LOAD           WRITE
LOC
```

5.3 Filenames And Paths

GW-BASIC uses MS-DOS 2.0's enhanced directory structure, allowing files to be accessed through their pathname.

5.3.1 Filename Specifications

File specifications follow MS-DOS 2.0 naming conventions. All filespecs may begin with a device specification such as A: or B: or COM1: or LPT1:. If no device is specified, the current drive is assumed. The default extension .BAS is appended to filenames used in LOAD, SAVE, MERGE and RUN <filename> commands, if no period (.) appears in the filespec and if the filename is less than nine characters long.

Examples:

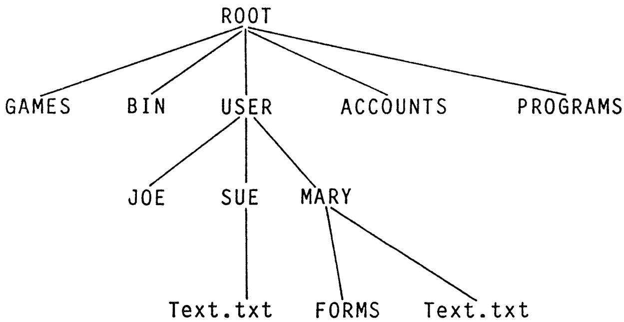
```
RUN "NEWFILE.BAS"
RUN "A:NEWFILE.BAS"
RUN "KYBD:NEWFILE.BAS"
SAVE "NEWFILE" (file is saved with .BAS extension on
default device)
```

5.3.2 Pathnames

A pathname is a sequence of directory names followed by a simple filename, each separated from the previous one by a backslash (\), and no longer than 128 characters. If a device is specified, it must be specified at the beginning of the pathname. A simple filename is a sequence of characters that can optionally be preceded by a drive designation, be devoid of backslashes, and be optionally followed by an extension.

```
[<d>:][<directory>]\[<directory...>]\[<filename>]
```

WORKING WITH FILES AND DEVICES



1A

A Sample Hierarchical Directory Structure

In the structure shown above, directories are in all upper-case letters. The two entries named Text.txt, and the entry named 1A are files.

If a pathname begins with a backslash, MS-DOS searches for the file beginning at the root (or top) of the tree. Otherwise, MS-DOS begins at the user's current directory, known as the working directory, and searches downward from there.

The pathname of Sue's TEXT.TXT file is \USER\SUE\TEXT.TXT.

When you are in your working directory, a filename and its corresponding pathname may be used interchangeably. Some sample names are:

\	Indicates the root directory.
\PROGRAMS	Sample directory under the root directory containing program files.
\USER\MARY\FORMS\1A	A typical full pathname. This one happens to be a file named 1A in the directory named FORMS belonging to the a subdirectory of USER named MARY.
USER\SUE	A relative pathname; it names the file or directory SUE in subdirectory USER of the working directory. If the working directory is the root (\), (\), it names \USER\SUE.
Text.txt	Name of a file or directory in the working directory.

MS-DOS provides special shorthand notations for the working directory and the parent directory (one level up) of the working directory:

name of the working directory in all hierarchical directory listings. MS-DOS automatically creates this entry when a directory is made.

directory. If you type:

```
DIR ..
```

then MS-DOS will list the files in the parent directory of your working directory.

If you type:

```
DIR ..\..
```

then MS-DOS will list the files in the parent's PARENT directory.

5.3.3 Working With Pathnames in BASIC

Not only can BASIC provide the ability to access files from other directories using pathname approaches, but it can also be used to create, change, and remove paths, using the BASIC commands MKDIR, CHDIR, and RMDIR.

The BASIC statement MKDIR ACCOUNTS would create a new directory, ACCOUNTS, in the working directory of the current drive.

The BASIC statement CHDIR B:EXPENSES would change the current directory on B: to EXPENSES.

The BASIC statement RMDIR CLIENTS would delete an existing directory, CLIENTS, as long as that directory was empty of all files with the exception of "." and "..".

For further information on handling paths in BASIC, see CHDIR, ENVIRON, ENVIRON$, MKDIR, and RMDIR Statements in Chapter 7.

5.4 Re-direction Of Standard Input And Standard Output

BASIC can be re-directed to read from standard input and write to standard output by providing the input and output filenames on the command line:

BASIC [program name] [<input file] [>output file]

Note that the characters "<" before the input file, and ">" before the output file are literally those characters, and not angle brackets indicating a required argument. If two greater-than characters (">>") appear before the output file name, the output is appended to that file.

Rules:

1. When re-directed, all INPUT, LINE INPUT, INPUT$, and INKEY$ statements will read from the input file.

2. If the program does not specify a file number in a PRINT statement, that output is redirected to the declared output file instead of the standard output device, the screen.

3. Error messages go to standard output.

4. File input from "KYBD:" still reads from the keyboard.

5. File output to "SCRN:" still outputs to the screen.

6. BASIC will continue to trap keys from the keyboard when the ON KEY(n) statement is used.

7. The printer echo key will not cause LPT1: echoing if Standard Output has been re-directed.

8. Typing Control-Break will cause BASIC to close any open files, issue the message "Break in line <line_number>" to standard output, and exit BASIC.

9. When input is redirected, BASIC will continue to read from this source until an end-of-file character is detected. This condition may be tested with the EOF function. If the file is not terminated by a Control-Z, or a BASIC input statement tries to read past end-of-file, then any open files are closed, the message "Read past end" is written to standard output, and BASIC terminates.

Examples:

```
GWBASIC MYPROG >DATA.OUT
```

Data read by INPUT and LINE INPUT will continue to come from the keyboard. Data output by PRINT will go into the file DATA.OUT.

```
GWBASIC MYPROG <DATA.IN
```

Data read by INPUT and LINE INPUT will come from DATA.IN. Data output by PRINT will continue to go to the screen.

```
GWBASIC MYPROG <MYINPUT.DAT> MYOUTPUT.DAT
```

Data read by INPUT and LINE INPUT will now come from the file MYINPUT.DAT and data output by PRINT will go into MYOUTPUT.DAT.

```
GWBASIC MYPROG <\SALES\JOHN\TRANS.>> \SALES\SALES.DAT
```

Data read by INPUT and LINE INPUT will now come from the file \SALES\JOHN\TRANS. Data output by PRINT will be appended to the file \SALES\SALES.DAT.

5.5 Handling Files

File I/O procedures for the beginning BASIC user are examined in this section. If you are new to BASIC, or if you are encountering file-related errors, read through these procedures and program examples to make sure you are using all the file statements correctly.

5.5.1 Program File Commands

The following is a review of the commands and statements used in program file manipulation. All file specifications may include the device and pathname.

SAVE <filespec>{[,A:P]} — Writes the program that currently resides in memory to the specified file. Option A writes the program as a series of ASCII characters. With option P, BASIC will encode the file in a read-protected format.

LOAD <filespec>[,R] — Loads the program from file into memory. The optional R runs the program immediately. LOAD always deletes the current contents of memory and closes all files before loading. If R is included, however, open data files are kept open. Thus, programs can be chained or loaded in sections and access the same data files. (LOAD FILESPEC>,R and RUN FILESPEC),R are equivalent.)

RUN <filespec>[,R] — Loads the program from file into memory and runs it. RUN deletes the current contents of memory and closes all files before loading the program. If the R option is included, however, all open data files are kept open. (RUN <filespec>,R and LOAD <filespec>,R are equivalent.)

MERGE <filespec> — Loads the program from file into memory but does not delete the current contents of memory. The program line numbers in the file are merged with the line numbers in memory. If two lines have the same number, only the line from the file program is saved. After a MERGE command is executed, the "merged" program resides in memory, and BASIC returns to command level. In order to successfully MERGE a program, the filespec must have been saved in ASCII format.

CHAIN [MERGE]<filespec>[,[<line number exp>][,ALL]
[,DELETE <range>]]

where, <line number expression> is the line number in the new program at which the program is to start execution. Passes control to the named program, and passes the use of the variables and their current values to the new program. The user may choose to start the new program on a specified line, delete some lines, or transfer the values of only some of the variables.

KILL <filespec>

Deletes the file from the disk. <filespec> can be a program file or a sequential or random access data file.

NAME<old filespec>
AS <new filespec>

Changes the name of a file. NAME AS <filespec> can be used with program files, random access files, or sequential files. Pathnames are not permitted.

5.5.2 Protecting Program Files

If you wish to have a program saved in an encoded binary format, use the "Protect" option with the SAVE command. For example:

```
SAVE "MYPROG",P
```

A program saved this way cannot be listed or edited. You may also want to save an unprotected copy of the program for listing and editing purposes.

5.6 Data Files: Sequential And Random Access I/O

There are two types of disk data files that can be created and accessed by a BASIC program: sequential files and random access files.

5.6.1 Sequential Files

Sequential files are easier to create than random access files, but are limited in flexibility and speed when it comes to locating data. The data written to a sequential file is a series of ASCII characters stored, one item after another (sequentially), in the order sent. The data is read back sequentially, one item after another.

The following statements and functions are used with sequential data files in sequential order.

OPEN
WIDTH
PRINT#
PRINT USING#
WRITE#
INPUT#
INPUT$
LINE INPUT#
EOF
LOC
LOF
CLOSE

5.6.1.1 Creating a Sequential File

Program 1 is a short program that creates a sequential file, "DATA," from information you input at the keyboard.

Program 1--Create a Sequential Data File

```
10 OPEN "O",#1,"DATA"
20 INPUT "NAME";N$
25 IF N$ = "DONE" THEN END
30 INPUT "DEPARTMENT";DEPT$
40 INPUT "DATE HIRED";HIREDATE$
50 PRINT#1,N$;",";DEPT$;",";HIREDATE$
60 PRINT
70 GOTO 20

RUN
```

```
NAME? SAMUEL GOLDWYN
DEPARTMENT? AUDIO/VISUAL AIDS
DATE HIRED? 01/12/72

NAME? MARVIN HARRIS
DEPARTMENT? RESEARCH
DATE HIRED? 12/03/65

NAME? DEXTER HORTON
DEPARTMENT? ACCOUNTING
DATE HIRED? 04/27/81

NAME? STEVEN SISYPHUS
DEPARTMENT? MAINTENANCE
DATE HIRED? 08/16/81

NAME? etc.
```

As illustrated in Program 1, the following program steps are required to create a sequential file and access the data in it:

1. OPEN the file in "O" mode.

2. Write data to the file using the PRINT# statement. (WRITE# can be used instead.)

3. To access the data in the file, you must CLOSE the file and reopen it in "I" mode.

4. Use the INPUT# statement to read data from the sequential file into the program.

5.6.1.2 Reading Data From a Sequential File

Now look at Program 2. It accesses the file "DATA" that was created in Program 1 and displays the name of everyone hired in 1981.

Program 2--Accessing a Sequential File

```
10 OPEN"I",#1,"DATA"
20 INPUT#1,N$,DEPT$,HIREDATE$
30 IF RIGHT$(HIREDATE$,2) = "81" THEN PRINT N$
40 GOTO 20
RUN

DEXTER HORTON
STEVEN SISYPHUS
Input past end in 20
```

Program 2 reads, sequentially, every item in the file, and prints the names of employees hired in 1981. When all the data has been read, line 20 causes an INPUT PAST END error. To avoid this error, use the WHILE...WEND control structure, which uses the EOF function to test for the end-of-file. The revised program looks like:

```
10 OPEN"I",#1,"DATA"
15 WHILE NOT EOF(1)
20     INPUT#1,N$,DEPT$,HIREDATE$
30     IF RIGHT$(HIREDATE$,2) = "81" THEN PRINT N$
40 WEND
```

A program that creates a sequential file can also write formatted data to the disk with the PRINT# USING statement. For example, the statement

```
PRINT#1,USING"####.##,";A,B,C,D
```

could be used to write numeric data to the file without explicit delimiters. The commas at the end of the format string separate the items in the disk file.

If the user wants commas to appear in the file as delimiters between variables, the WRITE statement can be used. For example, the statement

```
WRITE 1, A, B$
```

could be used to write these two variables to the file with commas delimiting them.

The LOC function, when used with a sequential file, returns the number of sectors that have been written to or read from the file since it was opened. A sector is a 128-byte block of data.

5.6.1.3 Adding Data to a Sequential File

If you have a sequential file residing on disk and want to add more data to the end of it, you cannot simply open the file in "O" mode and start writing data. As soon as you open a sequential file in the output ("O") mode, you destroy its current contents.

Instead, use the append ("A") mode. If the file doesn't already exist, the open statement will work exactly as it would if output ("O") mode had been specified.

The following procedure can be used to add data to an existing file called "FOLKS".

Program 3--Adding Data to a Sequential File

```
110 OPEN "A",#1,"FOLKS"
120 REM ADD NEW ENTRIES TO FILE
130  INPUT "NAME";N$
140  IF N$="" THEN 200 'CARRIAGE RETURN EXITS INPUT
LOOP
150  LINE INPUT "ADDRESS? ";ADDR$
160  LINE INPUT "BIRTHDAY? ";BIRTHDATE$
170  PRINT#1,N$
180  PRINT#1,ADDR$
190  PRINT#1,BIRTHDATE$
200 GOTO 120
210 CLOSE 1
```

5.6.2 Random Access Files

Creating and accessing random access files requires more program steps than creating and accessing sequential files. However, there are advantages to using random access files. One advantage is that random access files require less room on the disk, since BASIC stores them in a packed binary format. (A sequential file is stored as a series of ASCII characters.)

The biggest advantage of using random access files is that data can be accessed randomly, i.e., anywhere on the disk. However, it is not necessary to read through all the information from the beginning of the file, as with sequential files. This is possible because the information is stored and accessed in distinct units called records, each of which is numbered.

The statements and functions that are used with random access files are:

Statements	Functions
OPEN	CVD
FIELD	CVI
GET	CVS
LOC	MKS$
LOF	MKD$
LSET	MKI$
RSET	
PUT	
CLOSE	

5.6.2.1 Creating a Random Access File

Program 4--Create a Random File

```
10 OPEN "R",#1,"FILE",32
20 FIELD #1,20 AS N$, 4 AS A$, 8 AS P$
30 INPUT "2-DIGIT CODE";CODE%
40 INPUT "NAME";PERSON$
50 INPUT "AMOUNT";AMOUNT
60 INPUT "PHONE";TELELPHONE$
65 PRINT
70 LSET N$=PERSON$
80 LSET A$=MKS$(AMOUNT)
90 LSET P$=TELEPHONE$
100 PUT #1,CODE%
110 GOTO 30
```

As illustrated by Program 4, the following program steps are required to create a random access file.

1. OPEN the file for random access ("R" mode). The following example specifies a record length of 32 bytes. If the record length is not specified, the default is 128 bytes unless it was set to another value with the /I/S: switches when invoking BASIC (See Chapter 2 for details).

Example:

```
OPEN "R", 1,"FILE",32
```

2. Use the FIELD statement to allocate space in the random buffer for the variables that will be written to the random access file.

Example:

```
FIELD #1, 20 AS N$, 4 AS ADDR$, 8 AS P$
```

3. Use LSET to move the data into the random access buffer. Numeric values must be made into strings when placed in the buffer. To do this, use the "make" functions: MKI$ to make an integer value into a string, MKS$ to make a single precision value into a string, and MKD$ to make a double precision value into a string.

Example:

```
LSET N$=X$
LSET ADDR$=MKS$(AMT)
LSET P$=TEL$
```

4. Write the data from the buffer to the disk using the PUT statement.

Example:

PUT #1,CODE%

Program 4 takes information that is input at the terminal and writes it to a random access file. Each time the PUT statement is executed, a record is written to the file. The two-digit code that is input in line 30 becomes the record number.

NOTE

Do not use a fielded string variable in an INPUT or LET statement. Doing so causes that variable to be redeclared; BASIC will no longer associate that variable with the file buffer, but with the new program variable.

5.6.2.2 Accessing a Random Access File

Program 5 accesses the random access file "FILE" that was created in Program 4. By entering a three-digit code at the keyboard terminal, the information associated with that code is read from the file and displayed.

Program 5 -- Access a Random File

```
10 OPEN "R",#1,"FILE",32
20 FIELD #1, 20 AS N$, 4 AS A$, 8 AS P$
30 INPUT "2-DIGIT CODE";CODE%
40 GET #1, CODE%
50 PRINT N$
60 PRINT USING "$$###.##";CVS(A$)
70 PRINT P$:PRINT
80 GOTO 30
```

The following program steps are required to access a random access file:

1. OPEN the file in "R" mode.

Example:

```
OPEN "R", 1,"FILE",32
```

2. Use the FIELD statement to allocate space in the random access buffer for the variables that will be read from the file.

Example:

```
FIELD #1 20 AS N$, 4 AS A$, 8 AS P$
```

NOTE

In a program that performs both input and output on the same random access file, you can often use just one OPEN statement and one FIELD statement.

3. Use the GET statement to move the desired record into the random access buffer.

Example:

```
GET #1,CODE%
```

4. The data in the buffer can now be accessed by the program. Numeric values that were converted to strings by the MKS$, MKD$ or MKI$ statements must be converted back to numbers using the "convert" functions: CVI for integers, CVS for single precision values, and CVD for double precision values. The MKI$ and CVI processes mirror each other, the former converting a number into a format for storage in random files, the latter converting the random file storage into a format usable by the program.

Example:

```
PRINT N$
PRINT CVS(A$)
```

The LOC function when used with random access files, returns the "current record number." The current record number is the last record number that was used in a GET or PUT statement. For example, the statement

```
IF LOC(1) >50 THEN END
```

ends program execution if the current record number in file#1 is greater than 50.

5.6.2.3 Random File Operations

Program 6 is an inventory program that illustrates random file access.

Program 6--Inventory

```
120 OPEN"R",#1,"INVEN.DAT",39
125 FIELD#1,1 AS F$,30 AS D$, 2 AS Q$,2 AS R$,4 AS P$
130 PRINT:PRINT "FUNCTIONS:":PRINT
135 PRINT "1,INITIALIZE FILE"
140 PRINT "2,CREATE A NEW ENTRY"
150 PRINT "3,DISPLAY INVENTORY FOR ONE PART"
160 PRINT "4,ADD TO STOCK"
170 PRINT "5,SUBTRACT FROM STOCK"
180 PRINT "6,DISPLAY ALL ITEMS BELOW REORDER LEVEL"
220 PRINT:PRINT:INPUT"FUNCTION";FUNCTION
225 IF (FUNCTION < 1) OR (FUNCTION > 6) THEN PRINT
    "BAD FUNCTION NUMBER":GO TO 130
230 ON FUNCTION GOSUB 900,250,390,480,560,680
240 GOTO 220
250 REM ** BUILD NEW ENTRY **
260 GOSUB 840
270 IF ASC(F$)<>255 THEN INPUT "OVERWRITE"; ADDR$:
    IF ADDR$<>"Y" THEN RETURN
280 LSET F$=CHR$(0)
290 INPUT "DESCRIPTION";DESCRIPTION$
300 LSET D$=DESCRIPTION$
310 INPUT "QUANTITY IN STOCK";QUANTITY%
320 LSET Q$=MKI$(QUANTITY%)
330 INPUT "REORDER LEVEL";REORDER%
340 LSET R$=MKI$(REORDER%)
350 INPUT "UNIT PRICE";PRICE
360 LSET P$=MKS$(PRICE)
370 PUT#1,PART%
380 RETURN
390 REM ** DISPLAY ENTRY **
400 GOSUB 840
410 IF ASC(F$)=255 THEN PRINT "NULL ENTRY":RETURN
420 PRINT USING "PART NUMBER ###";PART%
430 PRINT D$
440 PRINT USING "QUANTITY ON HAND #####";CVI(Q$)
450 PRINT USING "REORDER LEVEL #####";CVI(R$)
460 PRINT USING "UNIT PRICE $$##.##";CVS(P$)
470 RETURN
480 REM ADD TO STOCK
490 GOSUB 840
```

```
500 IF ASC(F$)=255 THEN PRINT "NULL ENTRY":RETURN
510 PRINT D$:INPUT "QUANTITY TO ADD ";ADDITIONAL%
520 Q%=CVI(Q$)+ADDITIONAL%
530 LSET Q$=MKI$(Q%)
540 PUT#1,PART%
550 RETURN
560 REM REMOVE FROM STOCK
570 GOSUB 840
580 IF ASC(F$)=255 THEN PRINT "NULL ENTRY":RETURN
590 PRINT D$
600 INPUT "QUANTITY TO SUBTRACT";LESS%
610 Q%=CVI(Q$)
620 IF (Q%-LESS%)<0 THEN PRINT "ONLY";Q%;" IN STOCK":GOTO 600
630 Q%=Q%-LESS%
640 IF Q%=<CVI(R$) THEN PRINT "QUANTITY NOW";Q%;
    " REORDER LEVEL";CVI(R$)
650 LSET Q$=MKI$(Q%)
660 PUT#1,PART%
670 RETURN
680 DISPLAY ITEMS BELOW REORDER LEVEL
690 FOR I=1 TO 100
710 GET#1,I
720 IF CVI(Q$)<CVI(R$) THEN PRINT D$;" QUANTITY";
    CVI(Q$) TAB(50) "REORDER LEVEL";CVI(R$)
730 NEXT I
740 RETURN
840 INPUT "PART NUMBER";PART%
850 IF(PART%<1)OR(PART%°100) THEN PRINT "BAD PART NUMBER":
    GOTO 840 ELSE GET#1,PART%:RETURN
890 END
900 REM INITIALIZE FILE
910 INPUT "ARE YOU SURE";CONFIRM$:IF CONFIRM$<>"Y" THEN RETURN
920 LSET F$=CHR$(255)
930 FOR I=1 TO 100
940   PUT#1,I
950 NEXT I
960 RETURN
```

In this program, the record number is used as the part number. It is assumed the inventory will contain no more than 100 different part numbers. Lines 900-960 initialize the data file by writing CHR$(255) as the first character of each record. This is used later (line 270 and line 500) to determine whether an entry already exists for that part number.

Lines 130-220 display the various inventory functions that the program performs. When you type in the desired function number, line 230 branches to the appropriate subroutine.

5

5.7 BASIC And Child Processes

Through the use of the SHELL statement, GW-BASIC is able to use one of the most powerful features of MS-DOS: the ability to create child processes. SHELL enables the user to run part of a BASIC program, temporarily exit to MS-DOS to perform a specified function, and return to the BASIC program at the statement after the SHELL statement to proceed with the rest of the program.

BASIC will produce a child program when it uses the SHELL statement. It is not possible for BASIC to totally protect itself from its children. When a SHELL statement is executed, many things may be going on. For example, files may be OPEN and devices may be in use. It is advisable for programmers to thoroughly read about the SHELL Statement, Chapter 7, before using this powerful statement.

6 USING ADVANCED FEATURES

6.1 Assembly Language Subroutines

You may call assembly language subroutines from your GW-BASIC program with the USR function or the CALL or CALLS statement.

It is recommended that you use the CALL or CALLS statement for interfacing 8086 machine language programs with GW-BASIC. These statements are more readable and can pass multiple arguments. In addition, the CALL statement is compatible with more languages than its alternative, the USR function.

6.1.1 Memory Allocation

Memory space must be set aside for an assembly language subroutine before it can be loaded. To do so, use the /M: switch during start-up. The /M: switch sets the highest memory location to be used by GW-BASIC.

In addition to the GW-BASIC code area, GW-BASIC uses up to 64K of memory beginning at its data (DS) segment.

If more stack space is needed when an assembly language subroutine is called, you can save the GW-BASIC stack and set up a new stack for use by the assembly language subroutine. The GW-BASIC stack must be restored, however, before you return from the subroutine.

The assembly language subroutine can be loaded into memory in several ways, the most simple being to use the BLOAD command (see BLOAD Command, Section 7.6). Also, the user could SHELL a program that exits, but stays resident, leaving the linked, relocated image in memory. As a third choice, the user could execute a program that exits but stays resident, and then run BASIC.

The following guidelines must be observed if you choose to BLOAD, or read and poke, an EXE file into memory:

1. Make sure the subroutines do not contain any long references, address offsets that exceed 64K or that take the user out of the code segment. These long references require handling by the EXE loader.

2. Skip over the first 512 bytes (the header) of the linker's output file (EXE), then read in the rest of the file.

6.1.2 Internal Representation

The following section describes the internal representation of numbers in GW-BASIC. Knowledge of these arrangements is critical for many assembly language programming routines.

Single Precision - 24 bit mantissa

```
!   0   !   1   !   2   !   3   !
---------------------------------
! loman !       !s!himan!  exp  !
---------------------------------
```

```
where loman = the low mantissa
          S = the sign
      himan = the high mantissa
        exp = the exponent
        man = himan:...:loman
```

- If <exp> = 0, then number = 0.
- If <exp> <> 0, then the mantissa is normalized and

  <number> = <sgn> * .1<man> * 2 ** (<exp>-80h)

  That is, in single precision (hex notation - bytes low to high)

  ```
  00000080    =   .5
  00008080    =  -.5
  ```

Double Precision - 56 bit mantissa

```
!  0   !  1  !  2  !  3  !  4 !  5  !   6   !  7  !
---------------------------------------------------
  loman !     !     !     !     !S!himan!  exp  !
---------------------------------------------------
```

6.1.3 CALL Statement

The CALL statement is the recommended way of interfacing 8086 machine language subroutines with GW-BASIC. Do not use the USR function unless you are running previously written subroutines that already contain USR functions.

The syntax of the CALL statement is:

CALL<variable name>[(<argument list>)]

where <variable name> contains the offset into the current segment that is the starting point in memory of the subroutine being called. The current segment is either the default, or that which has been defined by a DEF SEG statement.

<argument list> contains the variables or constants, separated by commas, that are to be passed to the subroutine.

Invoking the CALL statement causes the following to occur:

1. For each argument in the argument list, the two-byte offset of the argument's location within the BASIC segment is pushed onto the stack.

2. Control is transferred to the subroutine with an 8086 long call to the segment address given in the last DEF SEG statement and the offset given in<variable name>.

   Figures 6.1 and 6.2 illustrate the state of the stack at the time the CALL statement is executed, and the condition of the stack during execution of the called subroutine, respectively.

```
                 !-----------------------!
                 !    argument 0         !
   high          !-----------------------!SP+4+(2*n)
 addresses       !    .                  !
     !           !    .                  !
     !           !    .                  !   Each argument is a 2-byte
     !           !-----------------------!   pointer into memory
     !c          !    argument n-1       !
    s!o          !-----------------------!SP+6
    t!u          !    argument n         !
    a!n          !-----------------------!SP+4
    c!t          ! return segment address!
    k!e          !-----------------------!SP+2
     !r          ! return offset         !
     !           !-----------------------!SP    --stack pointer
     V           !                       !      (SP register
    low          !                       !         contents)
 addresses       !                       !
```

Figure 6.1. Stack layout when CALL statement is activated

After the CALL statement has been activated, the subroutine has control. Arguments may be referenced by moving the stack pointer (SP) to the base pointer (BP) and adding a positive offset to BP.

```
                  -------------------------
   high          !                         !
 addresses       !    argument 0           !
       !         !    argument 1           !
       !         !    .                    !   <--Absent if any argument is
       !         !    .                    !         referenced within a nested
       !c        !    .                    !         procedure
      s!o        !    argument n           !
      t!u        !                         !
      a!n        !-------------------------!
      c!t        ! return segment address! <--Absent in local procedure
      k!e        !-------------------------!
       !r        ! return offset           !
       !         !-------------------------! <--stack pointer
       !         !                         !       (SP register
       !         !                         !          contents)
       !         !                         !
       !         !   local variables       !
       !         !   (data pushed on       !
       !         !    stack)               !
       !         !    .                    !
       !         !    .                    !
       !         !    .                    !
       !         !                         !
       !         !-------------------------!
       !         !   This space may be     !
       !         !   used during pro-      !   Stack pointer may change
       !         !   cedure execution      !    during procedure execution
       !         !    .                    !
       !         !    .                    !
       !         !    .                    !
       V         !                         !
      low        !                         !
      resses     !                         !
```

Figure 6.2. Stack layout during execution of a CALL statement

Observe the following rules when coding a subroutine:

1. The called routine must preserve segment registers DS, ES, SS, and the base pointer (BP). If interrupts are disabled in the routine, they must be enabled before exiting. The stack must be cleaned up on exit.

2. The called program must know the number and length of the arguments passed. The following routine shows an easy way to reference arguments:

```
PUSH   BP
MOV    BP,SP
ADD    BP, (2*number of arguments)+4
```

   Then:

   argument 0 is at BP
   argument 1 is at BP-2
   argument n is at BP-2*n

   (number of arguments = n+1)

3. Variables may be allocated either in the code segment or on the stack. Be careful not to modify the return segment and offset stored on the stack.

4. The called subroutine must clean up the stack. A preferred way to do this is to perform a RET<n> statement (where<n> is two times the number of arguments in the argument list) to adjust the stack to the start of the calling sequence.

5. Values are returned to GW-BASIC by including in the argument list the name of the variable that will receive the result. The internal format for numbers in GW-BASIC is discussed in "Internal Representation," Section 6.1.2.

6. If the argument is a string, the argument's offset points to 3 bytes which, as a unit, are called the "string descriptor." Byte 0 of the string descriptor contains the length of the string (0 to 255). Bytes 1 and 2, respectively, are the lower and upper 8 bits of the string starting address in string space.

Warning

If the argument is a string literal in the program, the string descriptor will point to program text. Be careful not to alter or destroy your program this way. To avoid unpredictable results, add +"" to the string literal in the program. For example, use

```
20 A$ = "BASIC"+""
```

This will force the string literal to be copied into string space. Then the string may be modified without affecting the program.

7. The contents of a string may be altered by user routines, but the descriptor must not be changed. Do not write past the end-of-string. GW-BASIC cannot correctly manipulate strings if their lengths are modified by external routines.

8. Data areas needed by the routine must be allocated either in the CODE segment of the user routine or on the stack. It is not possible to declare a separate data area in the user assembler routine.

Example of CALL statement:

```
100 DEF SEG=&H8000
110 FOO=&H7FA
120 CALL FOO(A,B$,C)
 .
 .
 .
```

Line 100 sets the segment to 8000 Hex. The value of variable FOO is added into the address as the low word after the DEF SEG value is left shifted 4 bits. Here, the long call to FOO will execute the subroutine at location 8000:7FA Hex (absolute address 807FA Hex).

The following sequence in 8086 assembly language demonstrates access to the arguments passed. The returned result is stored in the variable 'C'.

```
PUSH    BP              ;Set up pointer to arguments
MOV     BP,SP
ADD     BP,(4+2*3)
MOV     BX,[BP-2]       ;Get address of B$ descriptor.
MOV     CL,[BX]         ;Get length of B$ in CL.
MOV     DX,1[BX]        ;Get addr of B$ text in DX.
          .
          .
          .
MOV     SI,[BP]         ;Get address of 'A' in SI.
MOV     DI[BP-4]        ;Get pointer to 'C' in DI.
MOVS    WORD            ;Store variable 'A' in 'C'.
POP     BP              ;Restore pointer.
RET     6               ;Restore stack, return.
```

IMPORTANT

The called program must know the variable type for the numeric arguments passed. In the previous example, the instruction

MOVS WORD

will copy only two bytes. This is fine if variables A and C are integer. You would have to copy four bytes if the variables were single precision format and copy 8 bytes if they were double precision.

6.1.4 USR Function

Although using the CALL statement is the recommended way of calling assembly language subroutines, the USR function is also available for this purpose. This ensures compatibility with older programs that contain USR functions.

USR<digit>][(<argument>)]

where <digit> is from 0 to 9. <digit> specifies which USR routine is being called. If <digit> is omitted, USR0 is assumed.

<argument> is any numeric or string expression. Arguments are discussed in detail in the following paragraphs.

In the GW-BASIC Interpreter, a DEF SEG statement must be executed prior to a USR function call to assure that the code segment points to the subroutine being called. The segment address given in the DEF SEG statement determines the starting segment of the subroutine.

For each USR function, a corresponding DEF USR statement must be executed to define the USR function call offset. This offset and the currently active DEF SEG address determine the starting address of the subroutine.

When the USR function call is made, register AL contains a value that specifies the type of argument that was given. The value in AL may be one of the following:

Value in AL	Type of Argument
2	Two-byte integer (two's complement)
3	String
4	Single precision floating-point number
8	Double precision floating-point number

If the argument is a number, the BX register points to the Floating-Point Accumulator (FAC) where the argument is stored.

If the argument is an integer:

FAC-2 contains the upper 8 bits of the integer.
FAC-3 contains the lower 8 bits of the integer.

For versions of GW-BASIC that use binary floating-point:

FAC is the exponent minus 128, and the binary point is to the left of the most significant bit of the mantissa.

FAC-1 contains the highest 7 bits of mantissa with leading 1 suppressed (implied). Bit 7 is the sign of the number (0 = positive, 1 = negative).

If the argument is a single precision floating-point number:

FAC-2 contains the middle 8 bits of mantissa.
FAC-3 contains the lowest 8 bits of mantissa.

If the argument is a double precision floating-point number:

FAC-7 through FAC-4 contain four more bytes of mantissa (FAC-7 contains the lowest 8 bits).

If the argument is a string, the DX register points to 3 bytes which, as a unit, are called the "string descriptor." Byte 0 of the string descriptor contains the length of the string (0 to 255 characters). Bytes 1 and 2, respectively, are the lower and upper 8 bits of the string starting address in the GW-BASIC data segment.

Warning

If the argument is a string literal in the program, the string descriptor will point to program text. Be careful not to alter or destroy the program this way.

Usually, the value returned by a USR function is the same type (integer, string, single precision, or double precision) as the argument that was passed to it.

GW-BASIC has extended the USR function interface to allow calls to MAKINT and FRCINT. This allows access to these routines without giving their absolute addresses. The address ES:BP is used as an indirect far pointer to the routines FRCINT and MAKINT.

To call FRCINT from a USR routine use CALL DWORD ES:[BP].
To call MAKINT from a USR routine use CALL DWORD ES:[BP+4].

Example:

```
110 DEF USRO=&H8000 'Assumes decimal argument /M:32767
120 X=5
130 Y = USRO(X)
140 PRINT Y
```

The type (numeric or string) of the variable receiving the function call must be consistent with that of the argument used.

6.2 Event Trapping

Event trapping allows a program to transfer control to a specific program line when a certain event occurs. Control is transferred as if a GOSUB statement had been executed to the trap routine starting at the specified line number. The trap routine, after servicing the event, executes a RETURN statement that causes the program to resume execution at the place where it was when the event trap occurred.

The events that can be trapped are receipt of characters from a communications port (ON COM), detection of certain keystrokes (ON KEY), time passage (ON TIMER), emptying of the background music queue (ON PLAY) and joystick trigger activation (ON STRIG).

This section gives an overview of event trapping. For more details on individual statements, see Chapter 7.

Event trapping is controlled by the following statements:

<event specifier>ON to turn on trapping
<event specifier>OFF to turn off trapping
<event specifier>STOP to temporarily turn off trapping

where <event specifier> is one of the following:

COM(n) where n is the number of the communications channel. The n in (n) is the same device referred to in COMn:. The COM channels are numbered 1 through n, where n is implementation dependent.

Typically, the COM trap routine will read an entire message from the COM port before returning. We do not recommend using the COM trap for single character messages because at high baud rates the overhead of trapping and reading for each character may allow the interrupt buffer for COM to overflow.

KEY(n) where n is a trappable key number. Trappable keys are numbered 1 through n, where n is implementation dependent.

Note that KEY(n) ON is not the same statement as KEY ON. KEY(n) ON sets an event trap for the specified key. KEY ON displays the values of all the function keys on the twenty-fifth line of the screen (see Sections 7.65 and 7.66).

When the GW-BASIC Interpreter is in direct mode function keys maintain their standard meanings.

When a key is trapped, that occurrence of the key is destroyed. Therefore, you cannot subsequently use the INPUT or INKEY$ statements to find out which key caused the trap. So if you wish to assign different functions to particular keys, you must set up a different subroutine for each key, rather than assigning the various functions within a single subroutine.

TIMER ON TIMER(n), where (n) is a numeric expression representing a number of seconds since the previous midnight. The ON TIMER statement can be used to perform background tasks at defined intervals.

PLAY ON PLAY(n), where (n) is a number of notes left in the music buffer. The ON PLAY statement is used to retrieve more notes from the background music queue, to permit continuous background music during program execution.

STRIG(n) where n is the number of the joystick trigger. For most machines, the range for n is 0 through 2.

For discussion of STRIG used as a function, see Section 7.144.

6.2.1 ON GOSUB Statement

The ON GOSUB statement sets up a line number for the specified event trap. The format is:

ON <event specifier> GOSUB <line number>

A <line number> of zero disables trapping for that event.

When an event is ON and if a non-zero line number has been specified in the ON GOSUB statement, every time GW-BASIC starts a new statement it will check to see if the specified event has occurred (e.g., the lightpen has been struck or a COM character has come in). When an event is OFF, no trapping takes place, and the event is not remembered even if it takes place.

When an event is stopped (<event specifier> STOP), no trapping takes place, but the occurrence of an event is remembered so that an immediate trap will take place when an <event specifier> ON statement is executed.

When a trap is made for a particular event, the trap automatically causes a STOP on that event, so recursive traps can never occur. A return from the trap routine automatically executes an ON statement unless an explicit OFF has been performed inside the trap routine.

Note that once an error trap takes place, all trapping is automatically disabled. In addition, event trapping will never occur when GW-BASIC is not executing a program.

6.2.2 RETURN Statement

When an event trap is in effect, a GOSUB statement will be executed as soon as the specified event occurs. For example, the statement

ON COM(1) GOSUB 1000

specifies that the program go to line 1000 as soon as a character is available at the communication interface. If a simple RETURN statement is executed at the end of this subroutine, program control will return to the statement following the one where the trap occurred. When the RETURN statement is executed, its corresponding GOSUB return address is cancelled.

USING ADVANCED FEATURES

GW-BASIC includes the RETURN <line number> enhancement, which lets processing resume at a definable line. Normally, the program returns to the statement immediately following the GOSUB statement when the RETURN statement is encountered. However, RETURN line number enables the user to specify another line. If not used with care, however, this capability may cause problems. Assume, for example, that your program contains:

```
10 ON COM (1) GOSUB 1000
20 FOR I = 1 TO 10
30 PRINT I
40 NEXT I
50 REM NEXT PROGRAM LINE

200 REM PROGRAM RESUMES HERE

1000 'FIRST LINE OF SUBROUTINE
  .
  .
  .
1050 RETURN 200
```

If the communication event occurs while the FOR/NEXT loop is executing, the subroutine will be performed, but program control will return to line 200 instead of completing the FOR/NEXT loop. The original GOSUB entry will be cancelled by the RETURN statement, and any other GOSUB, WHILE, or FOR (e.g., an ON STRIG statement) that was active at the time of the trap will remain active. But the current FOR context will also remain active, and a "FOR without NEXT" error may result.

7 BASIC COMMANDS, FUNCTIONS AND STATEMENTS

7.1 ABS Function

Syntax ABS(X)

Purpose To return the absolute value of the expression X.

Example PRINT ABS(7*(-5))

will yield

35

7.2 ASC Function

Syntax ASC(X$)

Purpose To return a numerical value that is the ASCII code for the first character of the string X$. (See Appendix A for ASCII codes.)

Remarks If X$ is null, an "Illegal function call" error is returned.

Example

```
10 X$="TEST"
20 PRINT ASC(X$)
```

will yield

```
84
```

See the CHR$ function, Section 7.12, for details on ASCII-to-string conversion.

7.3 ATN Function

Syntax ATN(X)

Purpose To return the arctangent of X, where X is in radians. Result is in the range -pi/2 to pi/2 radians.

Remarks The expression X may be any numeric type, but the default evaluation of ATN is performed in single precision. This may be overridden if the /D switch is used when invoking GW-BASIC.

Example

```
10 LET X = 3
20 PRINT ATN(X)
```

will yield

1.249046

7.4 AUTO Command

Syntax AUTO [<line number>[,<increment>]]

Purpose To automatically generate line numbers during program entry.

Remarks AUTO begins numbering at <line number> and increments each subsequent line number by <increment>. The default for both values is 10. If <line number> is followed by a comma but <increment> is not specified, the last increment specified in an AUTO command is assumed.

If AUTO generates a line number that is already being used, an asterisk is printed after the number to warn the user that any input will replace the existing line. However, typing a carriage return immediately after the asterisk will save the existing line and generate the next line number.

If the cursor is moved to another line on the screen, numbering will resume there.

AUTO is terminated by typing CTRL-Break. The line in which the termination key is typed will not be saved. After the termination key is typed, Microsoft GW-BASIC returns to command level.

Example		
Example	AUTO 100,50	Generates line numbers 100, 150, 200 . . . .
	AUTO	Generates line numbers 10, 20, 30, 40 . . . .

7.5 BEEP Statement

Syntax BEEP

Purpose To sound the speaker.

Remarks The BEEP statement sounds the ASCII bell character. This statement has the same effect as PRINT CHR$(7) in nongraphics versions of MS-BASIC.

Example 20 IF X <20 THEN BEEP

This example executes a beep when X is less than 20.

7.6 BLOAD Command

Syntax

BLOAD <filespec> [,<offset>]

The device designation portion of the filespec is optional. The filename, not including the device designation, may be 1 to 8 characters long.

<offset> is a numeric expression returning an unsigned integer in the range 0 to 65535. This is the offset address at which loading is to start in the segment declared by the last DEF SEG statement.

Purpose

To load a specified memory image file into memory from any input device.

Remarks

The BLOAD statement allows a program or data that has been saved as a memory image file to be loaded anywhere in memory. A memory image file is a byte-for-byte copy of what was originally in memory. See BSAVE Command, in Section 7.7, for information about saving memory image files.

If the offset is omitted, the segment address and offset contained in the file (i.e., the address specified by the BSAVE statement when the file was created) are used. Therefore, the file is loaded into the same location from which it was saved.

If offset is specified, the segment address used is the one given in the most recently executed DEF SEG statement. If no DEF SEG statement has been given, the GW-BASIC data segment will be used as the default (because it is the default for DEF SEG).

CAUTION

BLOAD does not perform an address range check. It is therefore possible to load a file anywhere in memory. The user must be careful not to load over GW-BASIC or the operating system.

Example

```
10 'Load subroutine at 60:F000
20 DEF SEG=&H6000 'Set segment to 6000 Hex
30 BLOAD"PROG1",&HF000 'Load PROG1
```

This example sets the segment address at 6000 Hex and loads PROG1 at F000.

7.7 BSAVE Command

Syntax

BSAVE <filespec>,<offset>,<length>

The device designation portion of the filespec is optional. The filename, not including the device specification, must be 1 to 8 characters long.

<offset> is a numeric expression returning an unsigned integer in the range 0 to 65535. This is the offset address to start saving from in the segment declared by the last DEF SEG statement.

<length> is a numeric expression returning an unsigned integer in the range 1 to 65535. This is the length in bytes of the memory image file to be saved.

Purpose

To transfer the contents of the specified area of memory to any output device.

Remarks

The <filespec>, <offset>, and <length> are required in the syntax.

The BSAVE command allows data or programs to be saved as memory image files on disk or cassette. A memory image file is a byte-for-byte copy of what is in memory.

If the offset is omitted, a "Bad file name" error message is issued and the save is terminated. A DEF SEG statement must be executed before the BSAVE. The last known DEF SEG address will be used for the save.

If length is omitted, a "Bad file name" error message is issued and the save is terminated.

Example

```
10 'Save PROG1
20 DEF SEG=&H6000
30 BSAVE"PROG1",&HF000,256
```

This example saves 256 bytes starting at 6000:F000 in the file PROG1.

7.8 CALL Statement

Syntax

CALL <variable name>[(<argument list>)]

where <variable name> contains an address that is the starting point in memory of the subroutine. <variable name> may not be an array variable name.

<argument list> contains the arguments that are passed to the external subroutine. <argument list> may contain only variables.

Purpose

To call an assembly language subroutine or a compiled routine written in another high level language.

Remarks

The CALL statement is one way to transfer program flow to an external subroutine. (See also the USR function, Section 7.156.)

See Section 6.1.3., CALL Statement, for a detailed discussion of calling sequences.

Example

```
110 MYROUT=&HD000
120 CALL MYROUT(I,J,K)
          .
          .
          .
```

7.9 CDBL Function

Syntax CDBL(X)

Purpose To convert X to a double precision number.

Example

```
10 LET PI = 22/7
20 PRINT PI,CDBL(PI)
```

will yield

```
3.142857      3.142857074737549
```

7.10 CHAIN Statement

Syntax

CHAIN [MERGE]<filespec>[,[<line number exp>]
[,ALL][,DELETE <range>]]

See the examples below for illustration of the syntax options.

Purpose

To call a program and pass variables to it from the current program.

Remarks

<filespec> is a string expression containing a name that conforms to MS-DOS 2.0 rules for disk filenames or GW-BASIC rules for device specifications.

<line number exp> is a line number or an expression that evaluates to a line number in the called program. It is the starting point for execution of the called program. If it is omitted, execution begins at the first line. <line number exp> is not affected by a RENUM command.

With the ALL option, every variable in the current program is passed to the called program. If the ALL option is omitted, the current program must contain a COMMON statement to list the variables that are passed. See Section 7.21 for information about COMMON.

If the ALL option is used and <line number exp> is not, a comma must hold the place of <line number exp>. For example, CHAIN "NEXTPROG",,ALL is correct; CHAIN "NEXTPROG",ALL is incorrect. In the latter case, GW-BASIC assumes that ALL is a variable name and evaluates it as a line number expression.

The MERGE option allows a subroutine to be brought into the GW-BASIC program as an overlay. That is, the current program and the called program are merged (see MERGE Command, Section 7.84). The called program must be an ASCII file if it is to be merged.

After an overlay is used, it is usually desirable to delete it so that a new overlay may be brought in. To do this, use the DELETE option.

The line numbers in <range> are affected by the RENUM command.

Examples

CHAIN is used in different ways in the two examples below. In the first, the two string arrays are dimensioned, and declared as common variables. When the program gets to line 90, it chains to the other program, which loads the B$s. At line 90 of PROG2, control chains back to the first program, but line 100 is delineated, and so the first program executes from that line. This process can be observed through the descriptive text that prints as the programs execute.

Example 1

```
10  REM THIS PROGRAM DEMONSTRATES CHAINING USING
COMMON TO PASS VARIABLES.
20  REM SAVE THIS MODULE ON DISK AS "PROG1"
USING THE A OPTION.
30  DIM A$(2),B$(2)
40  COMMON A$(),B$()
50  A$(1)="VARIABLES IN COMMON MUST BE ASSIGNED"
60  A$(2)="VALUES BEFORE CHAINING."
70  B$(1)=""
80  B$(2) =""
90  CHAIN "PROG2"
100 PRINT
110 PRINT B$(1)
120 PRINT
130 PRINT B$(2)
140 PRINT
150 END
```

```
10  REM THE STATEMENT "DIM A$(2),B$(2)"
MAY ONLY BE EXECUTED ONCE.
20  REM HENCE, IT DOES NOT APPEAR IN THIS
MODULE.
30  REM SAVE THIS MODULE ON THE DISK AS "PROG2"
USING THE A OPTION.
40  COMMON A$(),B$()
50  PRINT
60  PRINT A$(1);A$(2)
70  B$(1)="NOTE HOW THE OPTION OF SPECIFYING
A STARTING LINE NUMBER"
80  B$(2)="WHEN CHAINING AVOIDS THE DIMENSION
STATEMENT IN 'PROG1'."
90  CHAIN "PROG1",100
100 END
```

In the second example, the MERGE, ALL, and DELETE options are illustrated. After A$ is loaded in the first program, control chains to line 1010 of the second. At the second program's line 1040, it chains to line 1010 of the third program, keeping all variables and deleting all the second program's lines.

Control passes to the third program. This process can be observed through the descriptive text that prints as the programs execute.

Example 2

```
10  REM THIS PROGRAM DEMONSTRATES CHAINING USING
THE MERGE, ALL, AND DELETE OPTIONS.
20  REM SAVE THIS MODULE ON THE DISK AS
"MAINPRG".
30  A$="MAINPRG"
40  CHAIN MERGE "OVRLAY1",1010,ALL
50  END


1000  REM SAVE THIS MODULE ON THE DISK AS
"OVRLAY1" USING THE A OPTION.
1010  PRINT A$; " HAS CHAINED TO OVRLAY1."
1020  A$="OVRLAY1"
1030  B$="OVRLAY2"
1040  CHAIN MERGE "OVRLAY2",1010,ALL,
DELETE 1000-1050
1050  END


1000  REM SAVE THIS MODULE ON THE DISK AS
"OVRLAY2" USING THE A OPTION.
1010  PRINT A$; " HAS CHAINED TO ";B$:"."
1020  END
```

Note

The CHAIN statement with MERGE option leaves the files open and preserves the current OPTION BASE setting.

If the MERGE option is omitted, CHAIN does not preserve variable types or user-defined functions for use by the chained program. That is, any DEFINT, DEFSNG, DEFDBL, DEFSTR, or DEFFN statements containing shared variables must be restated in the chained program.

When using the MERGE option, user-defined functions should be placed before any CHAIN MERGE statements in the program. Otherwise, the user-defined functions will be undefined after the merge is complete.

7.11 CHDIR Statement

Syntax CHDIR PATHNAME

Purpose To change the current operating directory.

Remarks PATHNAME is a string specifying the name of the directory which is to be the current directory. CHDIR works exactly like the MS-DOS command CHDIR. The PATHNAME must be a string of less than 128 characters.

Example CHDIR "SALES"

This makes SALES the current directory.

CHDIR "B:USERS"

This changes the current directory to USERS on drive B. It does NOT, however, change the default drive to B:.

Also see the MKDIR and RMDIR statements.

7.12 CHR$ Function

Syntax CHR$(I)

Purpose To return a string whose one character is ASCII character I. (ASCII codes are listed in Appendix A.)

Remarks CHR$ is commonly used to send a special character to the screen or printer. For instance, the BELL character (CHR$(7)) could be sent as a preface to an error message, or a form feed (CHR$(12)) could be sent to clear a terminal screen and return the cursor to the home position.

Example PRINT CHR$(66)

will yield

B

See the ASC function, Section 7.2, for details on ASCII-to-numeric conversion.

7.13 CINT Function

Syntax CINT(X)

Purpose To convert X to an integer by rounding the fractional portion.

Remarks If X is not in the range -32768 to 32767, an "Overflow" error occurs.

Example PRINT CINT(45.67)

"Overflow" error occurs.

Example PRINT CINT(45.67)

will yield

46

See the CDBL and CSNG functions for details on converting numbers to the double precision and single precision data type, respectively. See also the FIX and INT functions, both of which return integers.

7.14 CIRCLE Statement

Syntax

CIRCLE [STEP](<xcenter>,<ycenter>),<radius> [,<color>[,<start>,<end>[,<aspect>]]]

The [STEP] option makes the specified center and ycenter coordinates relative to the "most recent point", instead of absolute, mapped coordinates.

<xcenter> is the x coordinate for the center of the circle.

<ycenter> is the y coordinate for the center of the circle.

<radius> is the radius of the circle in the current logical coordinate system.

<color> is the numeric symbol for the color desired (see COLOR Statement, Section 7.19). The default color is the foreground color.

<start> and <end> are the start and end angles in radians. The range is -2 * pi through 2 * pi. These angles allow the user to specify where an ellipse will begin and end. If the start or end angle is negative, the ellipse will be connected to the center point with a line, and the angles will be treated as if they were positive. Note that this is different from adding 2 * pi. The start angle may be less than the end angle.

<aspect> is a numeric expression that affects the ratio of the x-radius to the y-radius. aspect is automatically set to 5/6 in medium resolution and 5/12 in high resolution. These values produce a visual circle given the standard screen aspect ratio of 4/3. The radius is measured in points in the horizontal direction.
If the aspect ratio is less than one, the radius given is the x radius. If it is greater than one, the y radius is given.

Purpose To draw an ellipse or circle with the specified center and radius.

Remarks The last point referenced after a circle is drawn is the center of the circle.

It is not an error to supply coordinates that are outside the screen or viewport.

Coordinates can be shown as absolutes, as in the syntax shown above, or the STEP option can be used to reference a point relative to the most recent point used. The syntax of the STEP option is:

STEP (<xoffset>,<yoffset>)

For example, if the most recent point referenced were (10,10), STEP (10,5) would reference a point offset 10 from the current x coordinate and offset 5 from the current y coordinate, that is, the point (20,15).

Example Assume that the last point plotted was 100,50. Then,

CIRCLE (200,200),50

and

CIRCLE STEP (100,150),50

will both draw a circle at 200,200 with radius 50. The first example uses absolute notation; the second uses relative notation.

7.15 CLEAR Statement

Syntax

CLEAR [,[<expression1>][,<expression2>]]

Purpose

To set all numeric variables to zero, all string variables to null, and to close all open files; and, optionally, to set the end of memory and the amount of stack space.

Remarks

<expression1> is a memory location that, if specified, sets the highest location available for use by Microsoft GW-BASIC.

<expression2> sets aside stack space for Microsoft GW-BASIC. The default is 768 bytes or one-eighth of the available memory, whichever is smaller.

Note

The CLEAR statement performs the following actions:

Closes all files.
Clears all COMMON variables.
Resets numeric variables and arrays to zero.
Resets the stack and string space.
Resets all string variables and arrays to null.
Releases all disk buffers.
Resets all DEF FN and DEF SNG/DBL/STR statements.

Examples

```
CLEAR

CLEAR ,32768

CLEAR ,,2000

CLEAR ,32768,2000
```

7.16 CLOSE Statement

Syntax: CLOSE [[#]<file number>[,[#]<file number...>]]

Purpose: To conclude I/O to a file. The CLOSE statement is complementary to the OPEN statement.

Remarks: <file number> is the number under which the file was opened. A CLOSE with no arguments closes all open files.

The association of a particular file and a file number terminates upon execution of a CLOSE statement. The file may then be reopened using the same or a different file number. Once a file is closed, that file's number may be used for any unopened file.

A CLOSE for a sequential output file writes the final buffer of output.

The SYSTEM, CLEAR, and END statements and the NEW and RESET commands always close all files automatically.

Example: CLOSE #1,#2

7.17 CLS Statement

Syntax CLS

Purpose Erases contents of entire current screen.

Remarks The screen may also be cleared with the Clear Window key (see discussion of CLEAR WINDOW in Section 4.2, "Full Screen Editor".)

Example

```
10 CLS 'Clears the screen
```

7.18 COLOR Statement (In Text Mode)

Syntax COLOR <foreground>,<background>,<border>

Purpose The statement will be used to modify the current default text foreground or background colors.

Remarks foreground is a numeric expression from 0 through 31, designating the character color.

background is a numeric expression from 0 through 7, designating the background color.

border is a numeric expression from 0 through 15, designating the border color.

The following colors are available for foreground:

0 Black
1 Blue
2 Green
3 Cyan
4 Red
5 Magenta
6 Brown
7 White
8 Gray
9 Light Blue
10 Light Green
11 Light Cyan
12 Light Red
13 Light Magenta
14 Yellow
15 High-intensity White

You will notice variation in the colors and their intensity, depending on your display device.

If you set foreground to 16 plus the number of the color you want (values 16 through 31), the characters will blink. For example, if you set foreground to 29 you will get blinking light magenta.

Only colors 0 through 7 are available for background.

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Note

1. You may create invisible characters, making the foreground color equal to the background color. By changing either the foreground or background color subsequent characters will be visible.

2. If you omit any parameter, the old value is used for that parameter.

3. Any parameter outside the numeric ranges specified for the machine will result in an "Illegal function call" error. In this case, previous values are retained.

Example

```
100 COLOR 13,2,1
```

This example produces a light magenta foreground, a green background, an a blue border screen.

7.19 COLOR Statement (In Graphics Mode)

Syntax COLOR <background> ,<palette>

Purpose Sets the background and palette colors in the graphic mode, medium resolution only.

Remarks <background> is a numeric expression that specifies the background color. The colors you can use for background are 0 through 31 (see the COLOR statement for text mode).

palette is a numeric expression that specifies your choice of palette colors.

You can select the following palette colors:

Color	Palette 0	Palette 1
1	Green	Cyan
2	Red	Magenta
3	Brown	White

In palette 0, the colors associated with numbers 1, 2, and 3 are Green, Red, and Brown, respectively.

In palette 1, the colors associated with numbers 1, 2, and 3 are Cyan, Magenta, and White respectively.

You may select a background color that is the same as a palette color.

The background and palette parameters may be omitted from the COLOR statement. In this case, the old values are used for the omitted parameters.

In graphics mode, the COLOR statement designates the background color and one palette (three colors). The PSET, PRESET, LINE, CIRCLE, PAINT, and DRAW statements may then select any of these four colors for display.

The COLOR statement has meaning in medium resolution only. If you use it in high resolution you will get an "Illegal function call" error.

Values used outside the range of 0 to 255 result in an "Illegal function call" error, but previous values are retainded.

Example

```
100 SCREEN 1
110 COLOR 8,1
```

Sets the background color to gray, and selects palette 1.

```
120 COLOR ,0
```

The background color stays gray, and palette changes to 0.

7.20 COM Statement

Syntax

```
COM(n) ON
COM(n) OFF
COM(n) STOP
```

Where (n) is the number of the communications port. The range for (n) is specified by the implementor.

Purpose

To enable or disable event trapping of communications activity on the specified port.

Remarks

The COM(n) ON statement enables communications event trapping by an ON COM statement (see ON COM Statement, Section 7.92). While trapping is enabled, and if a non-zero line number is specified in the ON COM statement, GW-BASIC checks between every statement to see if activity has occurred on the communications channel. If it has, the ON COM statement is executed.

COM(n) OFF disables communications event trapping. If an event takes place, it is not remembered.

COM(n) STOP disables communications event trapping, but if an event occurs, it is remembered. If there is a subsequent COM(n) ON statement, the remembered event will be successfully trapped.

Note

For additional information on communications event trapping, see "Event Trapping," Section 6.2, and ON COM Statement, Section 7.92.

Example

```
10 COM(1) ON
```

Enables error trapping of communications activity on channel 1.

7.21 COMMON Statement

Syntax COMMON<list of variables>

Purpose To pass variables to a chained program.

Remarks The COMMON statement is used in conjunction with the CHAIN statement. COMMON statements may appear anywhere in a program, though it is recommended that they appear at the beginning. The same variable cannot appear in more than one COMMON statement. Array variables are specified by appending "()" to the variable name. If all variables are to be passed, use CHAIN with the ALL option and omit the COMMON statement.

Some Microsoft products allow the number of dimensions in the array to be included in the COMMON statement. GW-BASIC will accept that syntax, but will ignore the numeric expression itself. For example, the following statements are both valid and are considered equivalent:

```
COMMON A()
COMMON A(3)
```

The number in parentheses is the number of dimensions, not the dimensions themselves. For example, the variable A(3) in this example might correspond to a DIM statement of DIM A(5,8,4).

Example

```
100 COMMON A,B,C,D(),G$
110 CHAIN "PROG3",10
 .
 .
 .
```

7.22 CONT Command

Syntax CONT

Purpose To continue program execution after a Break has been typed or a STOP statement has been executed.

Remarks Execution resumes at the point where the break occurred. If the break occurred after a prompt from an INPUT statement, execution continues with the reprinting of the prompt ("?" or prompt string).

CONT is usually used in conjunction with STOP for debugging. When execution is stopped, intermediate values may be examined and changed using direct mode statements. Execution may be resumed with CONT or a direct mode GOTO, which resumes execution at a specified line number. CONT may be used to continue execution after an error has occurred.

CONT is invalid if the program has been edited during the break.

Example See STOP Statement, Section 7.142.

7.23 COS Function

Syntax

COS(X)

Purpose

To return the cosine of X, where X is in radians.

Remarks

The calculation of COS(X) is performed in single precision, unless the /D switch is specified when BASIC is invoked and either the argument that receives the value of the cosine is a double precision variable or (X) is specified a double precision number with the # sign.

Example

```
10 X=2*COS(.4)
20 PRINT X
```

will yield

```
1.842122
```

7.24 CSNG Function

Syntax CSNG(X)

Purpose To convert X to a single precision number.

Example

```
10 A# = 975.3421115#
20 PRINT A#, CSNG(A#)
```

will yield

```
975.3421115   975.3421
```

See the CINT and CDBL functions for converting numbers to the integer and double precision data types, respectively.

7.25 CSRLIN Function

Syntax: CSRLIN

CSRLIN returns the current line position.

Purpose: To obtain the current line position of the cursor in a numeric variable.

Remarks: To return the current column position, use the POS function (Section 7.111).

Example:

```
10 y = CSRLIN 'Record current line.
20 x = POS(0) 'Record current column.
30 LOCATE 24,1
40 PRINT "HELLO"
50 LOCATE x,y 'Restore position to old
line and column
```


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7.26 CVI, CVS, CVD Functions

Syntax

```
CVI(<2-byte string>)
CVS(<4-byte string>)
CVD(<8-byte string>)
```

Purpose

To convert string values to numeric values.

Remarks

Numeric values that are read in from a random disk file must be converted from strings back into numbers. CVI converts a 2-byte string to an integer. CVS converts a 4-byte string to a single precision number. CVD converts an 8-byte string to a double precision number.

Example

```
 .
 .
 .
70 FIELD #1,4 AS N$, 12 AS B$, ...
80 GET #1
90 Y=CVS(N$)
 .
 .
 .
```

See also MKI$, MKS$, MKD$ Functions, Section 7.88.

7.27 DATA Statement

Syntax DATA <list of constants>

Purpose To store the numeric and string constants that are accessed by the program's READ statement(s). (See READ Statement, Section 7.120.)

Remarks DATA statements are nonexecutable and may be placed anywhere in the program. A DATA statement may contain as many constants as will fit on a line (separated by commas). Any number of DATA statements may be used in a program. READ statements access DATA statements in order (by line number). The data contained therein may be thought of as one continuous list of items, regardless of how many items are on a line or where the lines are placed in the program.

<list of constants> may contain numeric constants in any format; i.e., fixed-point, floating-point, or integer. (No numeric expressions are allowed in the list.) String constants in DATA statements must be surrounded by double quotation marks only if they contain commas, colons, or significant leading or trailing spaces. Otherwise, quotation marks are not needed.

The variable type (numeric or string) given in the READ statement must agree with the corresponding constant in the DATA statement.

DATA statements may be reread from the beginning by use of the RESTORE statement (Section 7.124).

Example See READ Statement, Section 7.120.

7.28 DATE$ Statement

Syntax

```
DATE$=<string expression>
```

<string expression> must be a string in one of the following forms:

```
mm-dd-yy
mm-dd-yyyy
mm/dd/yy
mm/dd/yyyy
```

Purpose

To set the current date. This statement complements the DATE$ function, which retrieves the current date.

Example

```
10 DATE$="07-01-1983"
```

The current date is set at July 1, 1983.

7.29 DATE$ Function

Syntax DATE$

Purpose To retrieve the current date. (To set the date, use the DATE$ statement, described in Section 7.28.)

Remarks The DATE$ function returns a ten-character string in the form mm-dd-yyyy, where mm is the month (01 through 12), dd is the day (01 through 31), and yyyy is the year (1980 through 2099).

Example

```
10 PRINT DATE$
```

The DATE$ function prints the date, calculated from the date set with the DATE$ statement.

7.30 DEF FN Statement

Syntax: DEF FN<name>[(<parameter list>)]=<function definition>

Purpose: To define and name a function that is written by the user.

Remarks: <name> must be a legal variable name. This name, preceded by FN, becomes the name of the function.

<parameter list> consists of those variable names in the function definition that are to be replaced when the function is called. The items in the list are separated by commas.

<function definition> is an expression that performs the operation of the function. It is limited to one logical line. Variable names that appear in this expression serve only to define the function; they do not affect program variables that have the same name. A variable name used in a function definition may or may not appear in the parameter list. If it does, the value of the parameter is supplied when the function is called. Otherwise, the current value of the variable is used.

The variables in the parameter list represent, on a one-to-one basis, the argument variables or values that will be given in the function call.

This statement may define either numeric or string functions. If a type is specified in the function name, the value of the expression is forced to that type before it is returned to the calling statement. If a type is specified in the function name and the argument type does not match, a "Type mismatch" error occurs.

A DEF FN statement must be encountered before the function it defines may be called. If a function is called before it has been defined, an "Undefined user function" error occurs. DEF FN is illegal in the direct mode.

Example

```
  .
  .
410 DEF FNAB(X,Y)=X^3/Y^2
420 T=FNAB(I,J)
  .
  .
```

Line 410 defines the function FNAB. The function is called in line 420.

7.31 DEFINT/SNG/DBL/STR Statements

Syntax

DEF<type><range(s) of letters>

where <type> is INT, SNG, DBL, or STR

Purpose

To declare variable types as integer, single precision, double precision, or string.

Remarks

Any variable names beginning with the letter(s) specified in <range of letters> will be considered the type of variable specified in the <type> portion of the statement. However, a type declaration character always takes precedence over a DEFtype statement. (See "Variable Names and Declaration Characters," Section 3.3.1.)

If no type declaration statements are encountered, GW-BASIC assumes that all variables without declaration characters are single precision variables.

Examples

10 DEFDBL L-P All variables beginning with the letters L, M, N, O, and P will be double precision variables.

10 DEFSTR A All variables beginning with the letter A will be string variables.

10 DEFINT I-N,W-Z
All variables beginning with the letters I, J, K, L, M, N, W, X, Y, Z will be integer variables.

7.32 DEF SEG Statement

Syntax DEF SEG [=<address>]

where <address> is a numeric expression returning an unsigned integer in the range 0 to 65535.

Purpose To assign the current segment address to be referenced by a subsequent BLOAD, BSAVE, CALL, or POKE statement or by a USR or PEEK function.

Remarks The address specified is saved for use as the segment required by BLOAD, BSAVE, CALL, POKE, USR, and PEEK.

Entry of any value outside the <address> range 0 through 65535 will result in an "Illegal function call" error, and the previous value will be retained.

If the <address> option is omitted, the segment to be used is set to the GW-BASIC data segment. This is the initial default value.

Note DEF and SEG must be separated by a space. Otherwise, GW-BASIC will interpret the statement DEFSEG=100 to mean "assign the value 100 to the variable DEFSEG."

Example

```
10 DEF SEG=&HB800 'Seg segment at B800 Hex
20 DEF SEG 'Restore segment to GW-BASIC data segment
```


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7.33 DEF USR Statement

Syntax DEF USR[<digit>]=<integer expression>

Purpose To specify the starting address of an assembly language subroutine.

Remarks <digit> may be any digit from 0 to 9. The digit corresponds to the number of the USR routine whose address is being specified. If <digit> is omitted, DEF USR0 is assumed. The value of <integer expression> is the starting address of the USR routine.

Any number of DEF USR statements may appear in a program to redefine subroutine starting addresses, thus allowing access to as many subroutines as necessary.

Example

```
.
.
.
200 DEF USR0=24000
210 X=USR0(Y^2/2.89)
.
.
.
```

7.34 DELETE Command

Syntax: DELETE {[<line number>][-<line number>][<line number>-]}

Purpose: To delete program lines.

Remarks: Microsoft GW-BASIC always returns to command level after a DELETE is executed. If <line number> does not exist, an "Illegal function call" error occurs.

Examples:

DELETE 40	Deletes line 40.
DELETE 40-100	Deletes lines 40 through 100, inclusive.
DELETE -40	Deletes all lines up to and including line 40.
DELETE 40-	Deletes lines 40 through the end, inclusive.

7.35 DIM Statement

Syntax DIM<list of subscripted variables>

Purpose To specify the maximum values for array variable subscripts and allocate storage accordingly.

Remarks If an array variable name is used without a DIM statement, the maximum value of the array's subscript(s) is assumed to be 10. If a subscript is used that is greater than the maximum specified, a "Subscript out of range" error occurs. The minimum value for a subscript is 0, unless otherwise specified with the OPTION BASE statement (see Section 7.101).

The DIM statement sets all the elements of the specified numerical arrays to an initial value of zero and elements of string arrays to null strings.

Theoretically, the maximum number of dimensions allowed in a DIM statement is 255. In reality, however, that number would be impossible, since the name and punctuation are also counted as spaces on the line, and the line itself has a limit of 255 characters.

If the default dimension (10) has already been established for an array variable, and that variable is later encountered in a DIM statement, an "Array already dimensioned" error results. Therefore, it is good programming practice to put the required DIM statements at the beginning of a program, outside of any processing loops.

Example

```
10 DIM A(20)
20 FOR I=0 TO 20
30   READ A(I)
40 NEXT I
 .
 .
 .
```

7.36 DRAW Statement

Syntax DRAW<string expression>

where <string expression> is one of the subcommands described below in "Remarks."

Purpose To draw an object defined by the subcommands described below.

Remarks The DRAW statement combines many of the capabilities of the other graphics statements into the Graphics Macro Language. The Graphics Macro Language defines a set of characteristics that comprehensively describe a particular image. In this case, the characteristics include motion (up, down, left, right), color, angle, and scale factor.

Each of the following subcommands initiates movement from the current graphics position. This is usually the coordinate of the last graphics point plotted with another GML command. The current position defaults to the center of the screen when a program is run.

Prefixes

The following prefix commands may precede any of the movement commands:

B Move but don't plot any points.

N Move but return to original position when done.

Cursor Movement

The following commands specify movement in units. The size of a unit may be modified by the S command. The default unit size is one point. If no argument is supplied, the cursor is moved one unit.

U [<n>] Move up (scale factor *n) points
D [<n>] Move down
L [<n>] Move left
R [<n>] Move right
E [<n>] Move diagonally up and right
F [<n>] Move diagonally up and left
G [<n>] Move diagonally down and left
H [<n>] Move diagonally down and right

Other Commands

M<x,y> Move absolute or relative. If x is preceded by a plus (+) or minus (-), x and y are added to the current graphics position and connected with the current position by a line. Otherwise, a line is drawn to point x,y from the current cursor position.

A<n> Set angle n. n may range from 0 to 3, where 0 is 0 degrees, 1 is 90, 2 is 180, and 3 is 270. Figures rotated 90 or 270 degrees are scaled so they will appear the same size as with 0 or 180 degrees on a monitor screen with the standard aspect ratio of 4/3.

TA<degrees> - rotate<degrees>.

DEGREES must be in the range -360 to 360 degrees. If DEGREES is positive, rotation is counter-clockwise. If DEGREES is negative, rotation is clockwise.

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Example:

```
FOR D=0 TO 360  'Draw spokes
DRAW "TA=D;NU50"
NEXT D
```

C <n>   Set color n.

S <n>   Set scale factor. n may range from 1 to 255. The scale factor multiplied by the distances given with U, D, L, R, or relative M commands gives the actual distance traveled.

X <string expression>

Execute substring. This powerful command allows you to execute a second substring from a string, much like a GOSUB in Microsoft BASIC. You can have one string execute another, which executes a third, and so on.

Numeric arguments can be constants like "123" or "=<variable>" where <variable> is the name of a variable.

P <paintcolor>, bordercolor .

<paintcolor> is an integer paint attribute, and <bordercolor> is the integer border attribute. "Tile" painting is not supported in Draw.

7

Examples

```
DRAW "U50R50D50L50" 'Draw a box
DRAW "BE10"                'Move up and right into
box
DRAW "P1,3"                'Paint interior

10 U$="U30;"
20 D$="D30;"
30 L$="L40;"
40 R$="R40;"
50 BOX$=U$+R$+D$+L$
60 DRAW "XBOX$;"
```

The statement DRAW "XU$;XR$;XD$;XL$;" would have drawn the same box.

7.37 EDIT Command

Syntax EDIT <line number>

Purpose To edit the specified line.

Remarks When EDIT is used, GW-BASIC types the specified program line and leaves the user in direct mode. The cursor is placed on the first character of the program line.

See Chapter 4, "Writing Programs Using the GW-BASIC Editor," for full details on screen editing capabilities.

7.38 END Statement

Syntax END

Purpose To terminate program execution, close all files, and return to command level.

Remarks END statements may be placed anywhere in the program to terminate execution. Unlike the STOP statement, END does not cause a "Break in line nnnnn" message to be printed. An END statement at the end of a program is optional. Microsoft GW-BASIC always returns to command level after an END is executed.

Example

```
520 IF K>1000 THEN END ELSE GOTO 20
```

7.39 ENVIRON Statement

Syntax	ENVIRON <string>
Purpose	To modify a parameter in MS-DOS's Environment String Table.
Remarks	<string> is a string expression. The value of the expression must be of the form <parameter-id> = <text>, or <parameter-id> <text>. Everything to the left of the equal sign or space will be assumed to be a parameter, and everything to the right, text.

If the parameter-id has not previously existed in the Environment String Table, it will be appended to the end of the table. If the parameter-id exists on the table when the ENVIRON statement is executed, the existing parameter-id is deleted and the new one appended to the end of the table.

The text string is the new parameter text. If the text is a null string (""), or consists only of a semicolon (";") then the existing parameter-id will be removed from the Environment String Table, and the remaining body of the file compressed.

This statement could be used to change the "PATH" parameter for a child process, or to pass parameters to a child by inventing a new Environment Parameter. (See the MS-DOS 2.0 Utilities - PATH Command).

Errors include parameters that are not strings and an "out of memory" when no more space can be allocated to the Environment String Table. The amount of free space in the table will usually be quite small.

Example

The following MS-DOS command will create a default "PATH" to the root directory on DISK A:

```
PATH=A:
```

The PATH may be changed to a new value by:

```
ENVIRON "PATH=A:SALES;A:ACCOUNTING"
```

A new parameter may be added to the Environment String Table:

```
ENVIRON "SESAME=PLAN"
```

The Environment String Table now contains:

```
PATH=A:SALES;A:ACCOUNTING
SESAME=PLAN
```

If you then entered:

```
ENVIRON "SESAME=;"
```

then you would have deleted SESAME, and you would have a table containing:

```
PATH=A:SALES;A:ACCOUNTING
```

Also see ENVIRON$ Function and SHELL Command, Sections 7.40 and 7.135, respectively.

7.40 ENVIRON$ Function

Syntax

ENVIRON$ (<string parameter>)
ENVIRON$ (<n>)

where n is an integer.

Purpose

To retrieve a parameter string from BASIC's Environment String Table.

Remarks

The string result returned by the ENVIRON$ function may not exceed 255 characters. If a parameter name is specified, and if it either cannot be found or it has no text following it, a null string is returned by ENVIRON$. When the parameter name is specified, ENVIRON$ returns all the associated text that follows "<parameter>=" in the Environment String Table.

If the argument is numeric, the the nth string in the Environment String Table is returned. It includes all the text, including the parameter name. If the nth string does not exist, a null string is returned.

7.41 EOF Function

Syntax EOF(<file number>)

Purpose To test for the end-of-file condition.

Remarks Returns -1 (true) if the end of a sequential file has been reached. Use EOF to test for end-of-file while inputting, to avoid "Input past end" errors.

When EOF is used with random access files, it returns "true" if the last executed GET statement was unable to read an entire record because of an attempt to read beyond the end.

When EOF is used with a communications device, the definition of the end-of-file condition is dependent on the mode (ASCII or binary) that the device was opened in. In binary mode, EOF is true when the input queue is empty (LOC(n)=0). It becomes false when the input queue is not empty. In ASCII mode, EOF is false until a Control-Z is received, and from then on it will remain true until the device is closed.

Example

```
10 OPEN "I",1,"DATA"
20 C=0
30 IF EOF(1) THEN 100
40 INPUT #1,M(C)
50 C=C+1:GOTO 30
 .
 .
 .
```

7.42 ERASE Statement

Syntax ERASE <list of array variables>

Purpose To eliminate arrays from memory.

Remarks Arrays may be redimensioned after they are erased, or the previously allocated array space in memory may be used for other purposes. If an attempt is made to redimension an array without first erasing it, a "Duplicate definition" error occurs.

Example

```
.
.
.
450 ERASE A,B
460 DIM B(99)
.
.
.
```

7.43 ERDEV,ERDEV$ FUNCTIONS

Syntax ERDEV ERDEV$

Purpose To provide a way to obtain device-specific status information. ERDEV is an integer function which contains the error code returned by the last device to declare an error. ERDEV$ is a string function which contains the name of the Device Driver which generated the error.

Remarks These functions may not be set by the programmer.

ERDEV is set by the Interrupt X'24' handler when an error within DOS is detected.

ERDEV will contain the INT 24 error code in the lower eight bits.

Example If a user-installed Device Driver, "MYLPT2", ran out of paper, and the Driver's error number for that problem was "9":

```
PRINT ERDEV, ERDEV$
```

will yield

```
9             MYLPT2
```

7.44 ERR And ERL FUNCTIONS

Syntax ERR ERL

Remarks When an error handling routine is entered, the function ERR contains the error code for the error and the function ERL contains the line number of the line in which the error was detected. The ERR and ERL functions are usually used in IF...THEN statements to direct program flow in the error handling routine.

With the GW-BASIC Interpreter, if the statement that caused the error was a direct mode statement, ERL will contain 65535.

If the line number is not on the right side of the relational operator, it cannot be renumbered with RENUM. Because ERL and ERR are reserved words, neither may appear to the left of the equal sign in a LET (assignment) statement. Microsoft GW-BASIC error codes are listed in Appendix B.

Example To test whether an error occurred in a direct statement, the user could enter:

```
IF 65535 = ERL THEN PRINT "Direct Error"
```

When testing within a program, use:

```
IF ERR=error code THEN ...

IF ERL=line number THEN ...
```

7.45 ERROR Statement

Syntax ERROR <integer expression>

Purpose To simulate the occurrence of a BASIC error, or to allow error codes to be defined by the user.

Remarks ERROR can be used as a statement (part of a program source line) or as a command (in direct mode).

The value of <integer expression> must be greater than 0 and less than 256. If the value of <integer expression> equals an error code already in use by BASIC (see Appendix B), the ERROR statement will simulate the occurrence of that error and the corresponding error message will be printed. (See Example 1.)

To define your own error code, use a value that is greater than any used by Microsoft GW-BASIC error codes. (It is preferable to use the highest available values, so compatibility may be maintained when more error codes are added to Microsoft GW-BASIC.) This user-defined error code may then be conveniently handled in an error handling routine. (See Example 2.)

If an ERROR statement specifies a code for which no error message has been defined, Microsoft GW-BASIC responds with the "Unprintable error" error message. Execution of an ERROR statement for which there is no error handling routine causes an error message to be printed and execution to halt.

Example 1

```
20 S=15
30 ERROR S
40 END
```

will yield

```
String too long in line 30
```

Or, in direct mode (interpreter only):

```
Ok
ERROR 15             (You type this line.)
String too long      (GW-BASIC types this line.)
Ok
```

Example 2

```
 .
 .
 .
110 ON ERROR GOTO 400
120 INPUT "WHAT IS YOUR BET";B
130 IF B>5000 THEN ERROR 210
 .
 .
 .
400 IF ERR=210 THEN PRINT "HOUSE LIMIT IS $5000"
410 IF ERL=130 THEN RESUME 120
 .
 .
 .
```

7.46 EXP Function

Syntax EXP(X)

Purpose To return e (base of natural logarithms) to the power of X. X must be <= 88.02969.

Remarks If x is greater than 88.02969, the "Overflow" error message is displayed, machine infinity with the appropriate sign is supplied as the result, and execution continues.

The EXP function will return a single precision value unless the /D switch was used when BASIC was invoked and a double precision variable is used as the argument.

Example

```
10 X=5
20 PRINT EXP(X-1)
```

will yield

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7.47 FIELD Statement

Syntax FIELD [#]<file number>,<field width> AS <string variable>...

Purpose To allocate space for variables in a random file buffer.

Remarks Before a GET statement or PUT statement can be executed, a FIELD statement must be executed to format the random file buffer.

<file number> is the number under which the file was opened. <field width> is the number of characters to be allocated to <string variable>.

The total number of bytes allocated in a FIELD statement must not exceed the record length that was specified when the file was opened. Otherwise, a "Field overflow" error occurs. (The default record length is 128 bytes.)

Any number of FIELD statements may be executed for the same file. All FIELD statements that have been executed will remain in effect at the same time.

Note Do not use a fielded variable name in an INPUT or LET statement. Once a variable name is fielded, it points to the correct place in the random file buffer. If a subsequent INPUT or LET statement with that variable name is executed, the variable no longer refers to the random file record buffer, but to the variables stored in string space.

Example 1 FIELD 1,20 AS N$,10 AS ID$,40 AS ADD$

Allocates the first 20 bytes in the random file buffer to the string variable N$, the next 10 bytes to ID$, and the next 40 to ADD$. FIELD does not place any data in the random file buffer. (See also GET Statement, Section 7.52, and LSET and RSET Statements, Section 7.83.)

Example 2

```
10 OPEN "R,"#1,"A:PHONELST",35
15 FIELD #1,2 AS RECNBR$,33 AS DUMMY$
20 FIELD #1,25 AS NAMES,10 AS PHONENBR$
25 GET #1
30 TOTAL=CVI(RECNBR)$
35 FOR I=2 TO TOTAL
40   GET #1, I
45   PRINT NAMES, PHONENBR$
50 NEXT I
```

Illustrates a multiple defined FIELD statement. In statement 15, the 35-byte field is defined for the first record to keep track of the number of records in the file. In the next loop of statements (35-50), statement 20 defines the field for individual names and phone numbers.

Example 3

```
10 FOR LOOP%=0 TO 7
20 FIELD #1,(LOOP%*16) AS OFFSET$,16 AS
A$(LOOP%)
30 NEXT LOOP%
```

Shows the construction of a FIELD statement using an array of elements of equal size. The result is equivalent to the single declaration:

```
FIELD #1,16 AS A$(0),16 AS A$(1),...,16 AS
A$(6),16 AS A$(7)
```

Example 4

```
10 DIM SIZE% (4%): REM ARRAY OF FIELD SIZES
20 FOR LOOP%=0 TO 4%
30    READ SIZE% (LOOP%)
40 NEXT LOOP%
50 DATA 9,10,12,21,41
 .
 .
 .
120 DIM A$(4%): REM ARRAY OF FIELDED VARIABLES
130 OFFSET%=0
140 FOR LOOP%=0 TO 4%
150 FIELD #1,OFFSET% AS OFFSET$,SIZE%(LOOP%)
AS A$(LOOP%)
160 OFFSET%=OFFSET%+SIZE%(LOOP%)
170 NEXT LOOP%
```

Creates a field in the same manner as Example 3. However, the element size varies with each element. The equivalent declaration is:

```
FIELD #1,SIZE%(0) AS A$(0),SIZE%(1) AS A$(1),...
SIZE%(4%) AS A$(4%)
```

7.48 FILES Statement

Syntax

FILES [<filespec>]

where <filespec> includes either a filename or a pathname and optional device designation.

Purpose

To print the names of files residing on the specified disk.

Remarks

If <filespec> is omitted, all the files on the currently selected drive will be listed. <filespec> is a string formula which may contain question marks (?) or asterisks (*) used as wild cards. A question mark will match any single character in the filename or extension. An asterisk will match one or more characters starting at that position. The asterisk is a shorthand notation for a series of question marks. The asterisk need not be used in the case where all the files on a drive are requested, e.g., FILES "B:".

If a filespec is used, and no explicit path is given, the current directory is the default.

Examples FILES

Shows all files on the current directory.

FILES "*.BAS"

Shows all files with extension .BAS.

FILES "B:*.*"

Shows all files on drive B.

FILES "B:" (equivalent to "B:*.*")

FILES "TEST?.BAS"

Shows all five-letter files whose names start with "TEST" and end with the .BAS extension.

FILES "\SALES"

If SALES is a subdirectory of the current directory, this statement displays SALES<dir>. If SALES is a file in the current directory, this statement displays SALES.

FILES "\SALES\MARY"

Displays MARY <dir> if MARY is a subdirectory of SALES or if MARY is a file, displays its name.

7.49 FIX Function

Syntax FIX(X)

Purpose To return the truncated integer part of X.

Remarks FIX(X) is equivalent to SGN(X)*INT(ABS(X)). The difference between FIX and INT is that FIX doe not return the next lower number for negative X.

Examples PRINT FIX(58.75)

will yield

 58

PRINT FIX(-58.75)

will yield

-58

7.50 FOR...NEXT Statement

Syntax

```
FOR<variable>=x TO y [STEP z]
 .
 .
 .
NEXT [<variable>][,<variable>...]
```

where x, y, and z are numeric expressions.

Purpose

To allow a series of instructions to be performed in a loop a given number of times.

Remarks

<variable> is used as a counter. The first numeric expression (x) is the initial value of the counter. The second numeric expression (y) is the final value of the counter. The program lines following the FOR statement are executed until the NEXT statement is encountered. Then the counter is adjusted by the amount specified by STEP. A check is performed to see if the value of the counter is now greater than the final value (y). If it is not greater, GW-BASIC branches back to the statement after the FOR statement and the process is repeated. If it is greater, execution continues with the statement following the NEXT statement. This is a FOR...NEXT loop.

If STEP is not specified, the increment is assumed to be one. If STEP is negative, the final value of the counter is set to be less than the initial value. The counter is decreased each time through the loop. The loop is executed until the counter is less than the final value.

The counter must be an integer or single precision numeric constant. If a double precision numeric constant is used, a "Type mismatch" error will result.

The body of the loop is skipped if the initial value of the loop times the sign of the STEP exceeds the final value times the sign of the STEP.

Nested Loops

FOR...NEXT loops may be nested; that is, a FOR...NEXT loop may be placed within the context of another FOR...NEXT loop. When loops are nested, each loop must have a unique variable name as its counter. The NEXT statement for the inside loop must appear before that for the outside loop. If nested loops have the same end point, a single NEXT statement may be used for all of them.

The variable(s) in the NEXT statement may be omitted, in which case the NEXT statement will match the most recent FOR statement. If a NEXT statement is encountered before its corresponding FOR statement, a "NEXT without FOR" error message is issued and execution is terminated.

Example 1

```
10 K=10
20 FOR I = 1 TO 10 STEP 2
30    PRINT I;
40    LET K = K+10
50    PRINT K
60 NEXT I
```

will yield

```
 1  20
 3  30
 5  40
 7  50
 9  60
```

In this example, the loop counter, I, advances +2 on each cycle. The loop prints the counter, increments K, and prints K.

Example 2

```
10 J=0
20 FOR I=1 TO J
30 PRINT I
40 NEXT I
```

In this example, the loop does not execute because the initial value of the loop exceeds the final value.

Example 3

```
10 I=5
20 FOR I=1 TO I+5
30    PRINT I;
40 NEXT I
```

will yield

```
1  2  3  4  5  6  7  8  9  10
```

In this example, the loop executes ten times. The final value for the loop variable is always set before the initial value is set.

7.51 FRE Function

Syntax FRE(0)
FRE("")

Purpose With a numeric argument, FRE returns the number of bytes in memory that are not being used by Microsoft GW-BASIC. Arguments to FRE are dummy arguments.

FRE("") forces a garbage collection before returning the number of free bytes.

Remarks GW-BASIC will not initiate garbage collection until all free memory has been used up. Therefore, using FRE("") periodically will result in shorter delays for each garbage collection.

Example PRINT FRE(0)

might yield

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7.52 GET Statement - File I/O

Syntax GET [#]<file number>[,<record number>]

Purpose To read a record from a random disk file into a random buffer.

Remarks <file number> is the number under which the file was OPENed. If <record number> is omitted, the next record (after the last GET) is read into the buffer. The largest possible record number is 16,777,215.

The GET and PUT statements allow fixed-length input and output for GW-BASIC COM files. However, because of the low performance associated with telephone line communications, we recommend that you do not use GET and PUT for telephone communication.

Example GET #1,75

Note After a GET statement has been executed, INPUT# and LINE INPUT# may be executed to read characters from the random file buffer. The EOF function may be used after a GET statement to see if that GET was beyond the end of file marker.

7.53 GET Statement - Graphics

Syntax

GET (x1,y1)-(x2,y2),<array name>

used with

PUT (x1,y1),<array name>[,action verb]

where (x1,y1) -(x2,y2) is a rectangular area on the display screen. The rectangle is defined with (x1,y1) and (x2,y2) being the upper-left and the lower right vertices.

<array name> is the name assigned to the place that will hold the image. The array can be any type except string. It must be dimensioned large enough to hold the entire image. Unless the array is type integer, the contents of the array after a GET will be meaningless when interpreted directly (see below).

Purpose

The GET and PUT statements are used together to transfer graphic images to and from the screen.

The GET statement transfers the screen image bounded by the rectangle described by the specified points into the array.

The PUT statement transfers the image stored in the array onto the screen.

Remarks

One of the most useful things that can be done with GET and PUT is animation. (See PUT Statement, Section 7.118 for discussion of animation.)

7.54 GOSUB...RETURN Statements

Syntax

```
GOSUB <line number>
 .
 .
 .
RETURN [<line number>]
```

Purpose

To branch to, and return from, a subroutine.

Remarks

<line number> in the GOSUB statement is the first line of the subroutine.

A subroutine may be called any number of times in a program. A subroutine also may be called from within another subroutine. Such nesting of subroutines is limited only by available memory.

Simple RETURN statement(s) in a subroutine cause Microsoft GW-BASIC to branch back to the statement following the most recent GOSUB statement. A subroutine may contain more than one RETURN statement.

The <line number>option may be included in the RETURN statement to return to a specific line number from the subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the GOSUB will remain active, and errors such as "FOR without NEXT" may result.

Subroutines may appear anywhere in the program, but it is recommended that the subroutine be readily distinguishable from the main program. To prevent inadvertent entry into the subroutine, precede it with a STOP, END, or GOTO statement that directs program control around the subroutine.

Example

```
10 GOSUB 40
20 PRINT "BACK FROM SUBROUTINE"
30 END
40 PRINT "SUBROUTINE";
50 PRINT " IN";
60 PRINT " PROGRESS"
70 RETURN
```

will yield

```
SUBROUTINE IN PROGRESS
BACK FROM SUBROUTINE
```

7.55 GOTO Statement

Syntax

GOTO <line number>

Purpose

To branch unconditionally to a specified line number.

Remarks

If <line number> is an executable statement, that statement and those following are executed. If it is a nonexecutable statement, execution proceeds at the first executable statement encountered after <line number>.

Example

```
10 READ R
20 PRINT "R =";R,
30 A=3.14*R 2
40 PRINT "AREA =";A
50 GOTO 10
60 DATA 5,7,12
```

will yield

```
R = 5           AREA = 78.5
R = 7           AREA = 153.86
R = 12          AREA = 452.16
Out of DATA in 10
```

7.56 HEX$ Function

Syntax HEX$(X)

Purpose To return a string that represents the hexadecimal value of the decimal argument.

Remarks X is rounded to an integer before HEX$(X) is evaluated.

Example

```
10 INPUT X
20 A$=HEX$(X)
30 PRINT X "DECIMAL IS " A$ " HEXADECIMAL"
```

will yield

```
? 32
32 DECIMAL IS 20 HEXADECIMAL
```

See the OCT$ function, Section 7.91, for details on octal conversion.

7.57 IF...THEN ...ELSE /IF...GOTO Statements

Syntax

IF <expression>[,]THEN {<statement(s)>|<line number>}

[,[ELSE {<statement(s)>|<line number>}]]

Syntax

IF <expression>[,]GOTO <line number>

[,[ELSE {<statement(s)>|<line number>}]]

Purpose

To make a decision regarding program flow based on the result returned by an expression.

Remarks

If the result of <expression> is not zero, the THEN or GOTO clause is executed. THEN may be followed by either a line number for branching or one or more statements to be executed. GOTO is always followed by a line number. If the result of <expression> is zero, the THEN or GOTO clause is ignored and the ELSE clause, if present, is executed. Execution continues with the next executable statement. A comma is allowed before THEN.

Nesting of IF Statements

IF...THEN...ELSE statements may be nested. Nesting is limited only by the length of the line. For example,

```
IF X>Y THEN PRINT "GREATER" ELSE IF X>Y
THEN PRINT "LESS THAN" ELSE PRINT "EQUAL"
```

is a legal statement. If the statement does not contain the same number of ELSE and THEN clauses, each ELSE is matched with the closest unmatched THEN. For example

```
IF A=B THEN IF B=C THEN PRINT "A=C"
ELSE PRINT "A<>C"
```

will not print "A<>C" when A<>B.

If an IF...THEN statement is followed by a line number in direct mode, an "Undefined line" error results, unless a statement with the specified line number had previously been entered in indirect mode.

Note

When using IF to test equality for a value that is the result of a floating-point computation, remember that the internal representation of the value may not be exact. Therefore, the test should be against the range over which the accuracy of the value may vary. For example, to test a computed variable A against the value 1.0, use:

```
IF ABS (A-1.0)<1.0E-6 THEN ...
```

This test returns true if the value of A is 1.0 with a relative error of less than 1.0E-6.

Example 1

```
200 IF I THEN GET#1,I
```

This statement GETs record number I if I is not zero.

Example 2

```
100 IF(I<20)*(I>10) THEN DB=1979-1:GOTO 300
110 PRINT "OUT OF RANGE"
 .
 .
 .
```

In this example, a test determines if I is greater than 10 and less than 20. If I is in this range, DB is calculated and execution branches to line 300. If I is not in this range, execution continues with line 110.

Example 3

```
210 IF IOFLAG THEN PRINT A$ ELSE LPRINT A$
```

This statement causes printed output to go either to the screen or the line printer, depending on the value of the variable IOFLAG. If IOFLAG is zero, output goes to the line printer; otherwise, output goes to the screen.

7.58 INKEY$ Function

Syntax INKEY$

Purpose To return either a one-character string containing a character read from the standard input device or a null string if no character is pending there. The keyboard is usually the standard input device.

Remarks No characters will be echoed. All characters are passed through to the program except for Break, which terminates the program.

Example

```
1000 'TIMED INPUT SUBROUTINE
1010 RESPONSE$=""
1020 FOR I%=1 TO TIMELIMIT%
1030   A$=INKEY$
1035   IF LEN(A$)=0 THEN 1060
1040   IF ASC(A$)=13 THEN TIMEOUT%=0
1045   IF TIMEOUT% = 0 THEN RETURN
1050   RESPONSE$=RESPONSE$+A$
1060 NEXT I%
1070 TIMEOUT%=1 : RETURN
```

Note Some keys may return a two-byte string, depending on your implementation.

7.59 INP Function

Syntax INP(I)

Purpose To return the byte read from port I. I must be in the range 0 to 65535.

Remarks INP is the complementary function to the OUT statement.

Example

```
100 A=INP(54321)
```

In 8086 assembly language, this is equivalent to:

```
MOV DX,54321
IN  AL,DX
```

7.60 INPUT Statement

Syntax INPUT[;] [<"prompt string">;]<list of variables>

Purpose To allow input from the keyboard during program execution.

Remarks When an INPUT statement is encountered, program execution pauses and a question mark is printed to indicate the program is waiting for data. If <"prompt string"> is included, the string is printed before the question mark. The required data is then entered at the keyboard.

BASIC can be re-directed to read from standard input and write to standard output by providing the input and output filenames when invoking BASIC. (See Section 2.1, "Invoking BASIC.")

A comma may be used instead of a semicolon after the prompt string to suppress the question mark. For example, the statement INPUT "ENTER BIRTHDATE",B$ will print the prompt with no question mark.

If INPUT is immediately followed by a semicolon, then the carriage return typed by the user to input data does not echo a carriage return/linefeed sequence.

The data that is entered is assigned to the variable(s) given in <variable list>. The number of data items supplied must be the same as the number of variables in the list. Data items are separated by commas.

The variable names in the list may be numeric or string variable names (including subscripted variables). The type of each data item that is input must agree with the type specified by the variable name. (Strings input to an INPUT statement need not be surrounded by quotation marks.)

Responding to INPUT with too many or too few items or with the wrong type of value (numeric instead of string, etc.) causes the message "?Redo from start" to be printed. No assignment of input values is made until an acceptable response is given.

Examples

```
10 INPUT X
20 PRINT X "SQUARED IS" X^2
30 END
```

will yield

? 5 (The 5 was typed in by the user in response to the question mark.)

5 SQUARED IS 25

```
10 PI=3.14
20 INPUT "WHAT IS THE RADIUS";R
30 A=PI*R^2
40 PRINT "THE AREA OF THE CIRCLE IS";A
50 PRINT
60 GOTO 20
```

will yield WHAT IS THE RADIUS? 7.4
(User types 7.4)

THE AREA OF THE CIRCLE IS 171.946

WHAT IS THE RADIUS?
etc.

7.61 INPUT# Statement

Syntax INPUT#<file number>,<variable list>

Purpose To read data items from a sequential device or file and assign them to program variables.

Remarks <file number> is the number used when the file was OPENed for input. <variable list> contains the variable names that will be assigned to the items in the file. (The variable type must match the type specified by the variable name.) With INPUT#, no question mark is printed, as with INPUT.

The data items in the file should appear just as they would if data were being typed in response to an INPUT statement. With numeric values, leading spaces, carriage returns, and linefeeds are ignored. The first character encountered that is not a space, carriage return, or linefeed is assumed to be the start of a number. The number terminates on a space, carriage return, linefeed, or comma.

If GW-BASIC is scanning the sequential data file for a string item, it will also ignore leading spaces, carriage returns, and linefeeds. The first character encountered that is not a space, carriage return, or linefeed is assumed to be the start of a string item. If this first character is a quotation mark ("), the string item will consist of all characters read between the first quotation mark and the second. Thus, a quoted string may not contain a quotation mark as a character. If the first character of the string is not a quotation mark, the string is an unquoted string, and will terminate on a comma, carriage return, or linefeed (or after 255 characters have been read). If end-of-file is reached when a numeric or string item is being INPUT, the item is terminated.

Example INPUT 2,A,B,C

7.62 INPUT$ Function

Syntax INPUT$(X[,[#]Y])

Purpose To return a string of X characters, read from file number Y. If the file number is not specified, the characters will be read from the standard input device. If input has not been redirected, the keyboard is the standard input device).

Remarks If the keyboard is used for input, no characters will be echoed on the screen. All control characters are passed through except Break which is used to interrupt the execution of the INPUT$ function.

BASIC can be re-directed to read from standard input by providing the input filename on the command line. (See Section 2.1,"Invoking BASIC.")

Example 1

```
5 'LIST THE CONTENTS OF A SEQUENTIAL FILE IN
HEXADECIMAL
10 OPEN"I",1,"DATA"
20 IF EOF(1) THEN 50
30 PRINT HEX$(ASC(INPUT$(1,#1)));
40 GOTO 20
50 PRINT
60 END
```

Example 2

```
 .
 .
 .
100 PRINT "TYPE P TO PROCEED OR S TO STOP"
110 X$=INPUT$(1)
120 IF X$="P" THEN 500
130 IF X$="S" THEN 700 ELSE 100
 .
 .
 .
```

7.63 INSTR Function

Syntax INSTR([I,]X$,Y$)

Purpose To search for the first occurrence of string Y$ in X$, and to return the position at which the match is found. Optional offset I sets the position for starting the search.

Remarks I must be in the range 1 to 255. If I is greater than the number of characters in X$ (LEN(X$)), or if X$ is null or Y$ cannot be found, INSTR returns 0. If Y$ is null, INSTR returns I or 1, and if no I was specified, then INSTR returns 1. X$ and Y$ may be string variables, string expressions, or string literals.

Example

```
10 X$="ABCDEB"
20 Y$="B"
30 PRINT INSTR(X$,Y$);INSTR(4,X$,Y$)
```

will yield

```
 2   6
```

7.64 INT Function

Syntax INT(X)

Purpose To return the largest integer <=X.

Examples PRINT INT(99.89)

will yield

99

PRINT INT(-12.11)

will yield

-13

See the CINT and FIX functions, Sections 7.13 and 7.49, respectively, which also return integer values.

7.65 KEY Statement

Syntax

```
KEY n, X$
KEY LIST
KEY ON
KEY OFF
```

n is the number of the function key.

X$ is the text assigned to the specified key.

Purpose

To assign softkey values to function keys and display the values.

Remarks

The KEY statement allows function keys to be designated for special "softkey" functions. Each of the function keys may be assigned a 15-byte string which will be input to GW-BASIC when that key is pressed.

Softkeys can be displayed with the KEY ON, KEY OFF, and KEY LIST statements.

KEY ON causes the softkey values to be displayed on the bottom line of the screen.

KEY OFF erases the softkey display from the bottom line, making that line available for program use. It does not disable the function keys.

KEY LIST displays all softkey values on the screen, with all 15 characters of each key displayed.

Assigning a null string (string of length 0) to a softkey disables the function key as a softkey.

If the function key number is not in the range of permissible function key numbers, an "Illegal function call" error is produced, and the previous key string expression is retained.

When a softkey is assigned, the INKEY$ function returns one character of the softkey string per invocation.

The soft keys are initially assigned as follows:

F1	LIST	F2	RUN
F3	LOAD"	F4	SAVE"
F5	CONT	F6	"LPT1:"
F7	TRON	F8	TROFF
F9	KEY	F10	SCREEN 0,0,0

Example

```
50 KEY ON 'Displays the softkey on bottom line
60 KEY OFF ' Erases softkey display
70 KEY 1,"MENU"+CHR$(13) '
```

Assigns the string "MENU" followed by a carriage return to softkey 1.

Such assignments might be used to speed data entry.

```
80 KEY 1,""  'Disables softkey 1
```

The following routine initializes the first five softkeys:

```
10 KEY OFF 'Turns off key display during
initialization
20 DATA "EDIT ","LET ","SYSTEM","PRINT ","LPRINT
"
30 FOR I = 1 TO 5
40   READ SOFTKEYS$(I)
50   KEY I,SOFTKEY$(I)
60 NEXT I
70 KEY ON 'Displays new softkeys
```

7.66 KEY(n) Statement

Syntax

KEY(n) ON
KEY(n) OFF
KEY(n) STOP

where n represents a numeric expression whose value ranges from one to 20, and specifies the key to be trapped:

1-10	functions keys F1 to F10
11	Cursor Up
12	Cursor Left
13	Cursor Right
14	Cursor Down
15-20	keys defined by the syntax: KEY n,CHR$(s)+CHR$(t) (keys 15-20 are trappable only in BASIC 2.0 and later)

Purpose

To enable or disable event trapping of softkey or cursor direction key activity for the specified trappable key.

Remarks

Note that the KEY statement described in Section 7.65 assigns softkey and cursor direction values to function keys and displays the values. Do not confuse KEY ON and KEY OFF, which display and erase these values, with the event trapping statements described in this section.

The KEY(n) ON statement enables softkey or cursor direction key event trapping by an ON KEY statement (see ON KEY Statement, Section 7.95). While trapping is enabled, and if a non-zero line number is specified in the ON KEY statement, GW-BASIC checks between every statement to see if a softkey or cursor direction key has been used. If it has, the ON KEY statement is executed. The text that would normally be associated with a function key will not be printed.

KEY(n) OFF disables the event trap. If an event takes place, it is not remembered.

KEY(n) STOP disables the event trap, but if an event occurs, it is remembered and an ON KEY statement will be executed as soon as trapping is enabled.

Note

For additional information on key event trapping, see "Event Trapping," Section 6.2, and "ON KEY Statement," Section 7.95.

Example

```
10 KEY 4,SCREEN 0,0 ' assigns softkey 4
20 KEY(4) ON 'enables event trapping
.
.
.
70 ON KEY(4) GOSUB 200
.
.
.
key 4 pressed
.
.
.
200 'Subroutine for screen
```

7.67 KILL Statement

Syntax KILL [<filespec>]

Purpose To delete a file or a pathname from disk.

Remarks If a KILL statement is given for a file that is currently open, a "File already open" error occurs.

KILL is used for all types of disk files: program files, random data files, and sequential data files. The filespec may contain question marks (?) or asterisks (*) used as wildcards. A question mark will match any single character in the filename or extension. An asterisk will match one or more characters starting at its position.

Since it is possible to reference the same file in a sub-directory via different paths, it is nearly impossible for BASIC to know that it is indeed the same file simply by looking at the path. For example; if MARY is your current directory, then:

```
"REPORT" ...
"\SALES\MARY\REPORT" ...
"..\MARY\REPORT" ...
"..\..\MARY\REPORT" ...
```

all refer to the same file. Therefore, any open file with the same file name will cause a "file already open" error.

WARNING

Be extremely careful when using wildcards with this command.

Examples

```
200 KILL "DATA1?.DAT"
```

The position taken by the question mark will match any valid filename character. This command will kill any file that has a six character name starting with "DATA1" and has the filename extension ".DAT". This includes "DATA10.DAT" and "DATA1Z.DAT".

```
210 KILL "DATA1.*"
```

Kills all files named DATA1, regardless of the filename extension.

```
220 KILL "..\GREG\*.DAT"
```

Kills all files with the extension ".DAT" in a directory called GREG.

7.68 LEFT$ Function

Syntax LEFT$(<string>,I)

Purpose To return a string comprising the leftmost I characters of X$.

Remarks I must be in the range 0 to 255. If I is greater than the number of characters in <string>, (LEN(X$)), the entire string (<string>) will be returned. If I = 0, the null string (length zero) is returned.

Example

```
10 A$="BASIC LANGUAGE"
20 B$=LEFT$(A$,5)
30 PRINT B$
```

will yield

```
BASIC
```

Also see the MID$ and RIGHT$ functions, Sections 7.85 and 7.127, respectively.

7.69 LEN Function

Syntax LEN(<string>)

Purpose To return the number of characters in <string>. Nonprinting characters and blanks are counted.

Example

```
10 X$="PORTLAND, OREGON"
20 PRINT LEN(X$)
```

will yield

```
16
```

7.70 LET Statement

Syntax [LET]<variable>=<expression>

Purpose To assign the value of an expression to a variable.

Remarks Notice that the word LET is optional; i.e., the equal sign is sufficient for assigning an expression to a variable name.

Example

```
110 LET D=12
120 LET E=12^2
130 LET F=12^4
140 LET SUM=D+E+F
  .
  .
  .
```

or

```
110 D=12
120 E=12^2
130 F=12^4
140 SUM=D+E+F
  .
  .
  .
```

7.71 LINE Statement

Syntax

```
LINE [[STEP](x1,y1)]-[STEP](x2,y2)
[,[<color>][,b[f]]][,style]
```

(x1,y1) is the coordinate for the starting point of the line.

(x2,y2) is the ending point for the line.

The STEP option makes the specified coordinates relative to the "most recent point", instead of absolute, mapped coordinates.

<color> is the number of the color in which the line should be drawn. (See COLOR statement, Section 7.19.) If the ,b or ,bf option is used, the box is drawn in this color.

,b draws a box with the points (x1,y1) and (x2,y2) specifying the upper left and lower right corners.

,bf draws a filled box.

,style is a 16-bit integer mask used when putting pixels down on the screen. This is called "line styling".

Purpose

To draw a line or box on the screen.

Remarks

When coordinates specify a point that is not in the current viewport, the line segment is clipped to the viewport.

The relative coordinate form STEP (xoffset,yoffset) can be used in place of an absolute coordinate. For example, assume that the most recent point referenced was (10,10). The statement LINE STEP (10,5) would specify a point at offset 10 from x and offset 5 from y, that is, (20,15).

If the STEP option is used for the second coordinate on a LINE statement, it is relative to the first coordinate in the statement. Other ways to establish a new "most recent point" are to initialize the screen with the CLS and SCREEN statements (Sections 7.17 and 7.132, respectively). Using the PSET, PRESET, CIRCLE and DRAW statements will establish a new "most recent point".

Each time LINE stores a point on the screen, it uses the current circulating bit in [style]. If that bit is a 0, then no storing will be done; if the bit is a 1 the point is stored. After each point is stored, the next bit position in [style] is selected. Since a 0 bit in [style] causes no change to the point on the screen, the user may prefer to draw a background line before a 'styled' line in order to force a known background. Style is used for normal lines and boxes, but has no effect on filled boxes.

Examples

The following examples assume a screen 320 pixels wide by 200 pixels high.

```
10 LINE -(x2,y2)
```

Draws a line from the last point to x2,y2 in the foreground color.

```
20 LINE (0,0)-(319,199)
```

Draws a diagonal line across the screen (downward).

```
30 LINE (0,100)-(319,100)
```

Draws a line across the screen.

```
40 LINE (10,10)-(20,20),2
```

Draws a line in color 2.

```
10 FOR x=0 to 319
20 LINE (x,0)-(x,199),x AND 1
30 NEXT
```

Draws an alternating line on-line off pattern on a monochrome display.

```
10 LINE (0,0)-(100,100),,b
```

Draws a box in the foreground (note that the color is not included).

```
20 LINE STEP (0,0)-STEP (200,200),2,bf
```

Draws a filled box in color 2. Coordinates are given as offsets.

```
10 LINE (0,0)-(160,100),3,,&HFF00
```

Draws a dashed line from the upper left hand corner to the center of the screen.

7.72 LINE INPUT Statement

Syntax LINE INPUT[;] [<"prompt string">;] <string variable>

Purpose To input an entire line (up to 254 characters) to a string variable, without the use of delimiters.

Remarks <"prompt string"> is a string literal that is printed at the terminal before input is accepted. A question mark is not printed unless it is part of <"prompt string">. All input from the end of <"prompt string"> to the carriage return is assigned to <string variable>. However, if a linefeed/carriage return sequence (this order only) is encountered, both characters are echoed; but the carriage return is ignored, the linefeed is put into <string variable>, and data input continues.

If LINE INPUT is immediately followed by a semicolon, then the carriage return typed by the user to end the input line does not echo a carriage return/linefeed sequence at the terminal.

A LINE INPUT statement may be aborted by typing Control-C. GW-BASIC will return to command level. If you are using the interpreter, typing CONT resumes execution at the LINE INPUT.

Example See LINE INPUT# Statement, Section 7.73.

7.73 LINE INPUT# Statement

Syntax LINE INPUT#<file number>,<string variable>

Purpose To read an entire line (up to 255 characters), without delimiters, from a sequential disk data file to a string variable.

Remarks <file number> is the number under which the file was OPENed. <string variable> is the variable name to which the line will be assigned. LINE INPUT# reads all characters in the sequential file up to a carriage return. It then skips over the carriage return/linefeed sequence. The next LINE INPUT# reads all characters up to the next carriage return. (If a linefeed/carriage return sequence is encountered, it is preserved.)

LINE INPUT# is especially useful if each line of a data file has been broken into fields, or if a GW-BASIC program saved in ASCII format is being read as data by another program. (See SAVE Command, Section 7.131.)

When GW-BASIC is invoked with redirected input and output, all LINE INPUT statements will read from the input file specified instead of the keyboard.

When input is redirected, GW-BASIC will continue to read from this source until a control-Z is detected. This condition may be tested with the EOF function. If the file is not terminated by a control-Z, or a BASIC file input statement tries to read past end-of-file, then any open files are closed, the message "Read past end" is written to standard output, and BASIC returns to MS-DOS.

Example

```
10 OPEN "O",1,"LIST"
20 LINE INPUT "CUSTOMER INFORMATION? ";C$
30 PRINT #1, C$
40 CLOSE 1
50 OPEN "I",1,"LIST"
60 LINE INPUT #1, C$
70 PRINT C$
80 CLOSE 1
```

will yield

```
CUSTOMER INFORMATION? LINDA JONES  234,4  MEMPHIS
LINDA JONES    234,4    MEMPHIS
```

7.74 LIST Command

Syntax

LIST [<line number>] [-[<line number>]] [,<device>]

<line number> is in the range 0 to 65529.

<device> is a device designation string, such as SCRN: or LPT:, or a filename.

Purpose

To list all or part of the program currently in memory.

Remarks

GW-BASIC always returns to command level after a LIST is executed.

If <line number> is omitted, the program is listed beginning at the lowest line number. (Listing is terminated either when the end of the program is reached or by typing Break.) If <line number> is included, only the specified line will be listed.

If only the first <line number> is specified, that line and all higher-numbered lines are listed.

If only the second <line number> is specified, all lines from the beginning of the program through that line are listed.

If both <line number(s)> are specified, the entire range is listed.

If the <device> is omitted, the listing is shown at the terminal.

Examples

LIST	Lists the program currently in memory.
LIST 500	Lists line 500.
LIST 150-	Lists all lines from 150 to the end.
LIST -1000	Lists all lines from the lowest number through 1000.
LIST 150-1000	Lists lines 150 through 1000, inclusive.
LIST 150-1000,"LPT:"	Lists lines 150 through 1000 on the line printer.

7.75 LLIST Command

Syntax LLIST [<line number>[-[<line number>]]]

Purpose To list all or part of the program currently in memory on the line printer.

Remarks LLIST assumes a 132-character-wide printer.

GW-BASIC always returns to command level after an LLIST is executed. The options for LLIST are the same as for the LIST Command, Section 7.74.

Example See the examples for the LIST Command, Section 7.74. With the exception of the last one, which addresses a device, LLIST will work in a similar way.

7.76 LOAD Command

Syntax LOAD <filespec>[,R]

Purpose To load a file from an input device into memory.

Remarks For loading a program, the <filespec> is an optional device specification followed by a filename or pathname that conforms to MS-DOS 2.0's rules for filenames. BASIC appends the default filename extension .BAS if the user specifies no extensions, when the file is saved to the disk.

The <filespec> must include the filename that was used when the file was saved, or created by an editor. (BASIC will append a default filename extension if one was not supplied in the SAVE command.)

The R option automatically runs the program after it has been loaded.

LOAD closes all open files and deletes all variables and program lines currently residing in memory before it loads the designated program. However, if the R option is used with LOAD, the program is run after it is loaded, and all open data files are kept open. Thus, LOAD with the R option may be used to chain several programs (or segments of the same program). Information may be passed between the programs using their disk data files.

Example LOAD "STRTRK",R

Loads and runs the program STRTRK.BAS

LOAD "B:MYPROG"

Loads the program MYPROG.BAS from the disk in drive B, but does not run the program.

7.77 LOC Function

Syntax

LOC(<file number>)

where <file number> is the number under which the file was opened.

Purpose

With random disk files, LOC returns the actual record number within the file.

With sequential files, LOC returns the current byte position in the file, divided by 128.

Remarks

When a file is opened for APPEND or OUTPUT, LOC returns the size of the file in (bytes/128).

For a communications file, LOC(X) is used to determine if there are any characters in the input queue waiting to be read. If there are more than 255 characters in the queue, LOC(X) returns 255. Since interpreter strings are limited to 255 characters, this practical limit alleviates the need for an interpreter user to test for string size before reading data into it.

If fewer than 255 characters remain in the queue, the value returned by LOC(X) depends on whether the device was opened in ASCII or binary mode. In either mode, LOC will return the number of characters that can be read from the device. However, in ASCII mode, the low level routines stop queueing characters as soon as end-of-file is received. The end-of-file itself is not queued and cannot be read. An attempt to read the end-of-file will result in an "Input past end" error.

Example

```
200 IF LOC(1)>50 THEN STOP
```

7.78 LOCATE Statement

Syntax

LOCATE [row][,[col][,[cursor][,[start][,stop]]]]

<row> is a line number (vertical) on the screen. Row should be a numeric expression returning an unsigned integer.

<col> is the column number on the screen. It should be a numeric expression returning an unsigned integer.

<cursor> is a Boolean value indicating whether the cursor should be visible or not.

<start> is the cursor starting line (vertical) on the screen. It should be a numeric expression returning an unsigned integer.

<stop> is the cursor stop line (vertical) on the screen. It should be a numeric expression returning an unsigned integer.

Purpose

Moves the cursor to the specified position. Optional parameters turn the blinking cursor on and off and define the vertical start and stop lines.

Remarks

Any value outside the specified ranges will result in an "Illegal function call" error. In this case, previous values are retained.

Any parameter may be omitted from the statement. If a parameter is omitted, the previous value is assumed.

Note that the <start> and <stop> lines are the raster lines that specify which pixels on the screen are lit. A wider range between the start and stop lines will produce a taller cursor, such as one that occupies an entire character block.

If the <start> line is given but the <stop> line is omitted, <stop> assumes the same value as <start>.

The last line on the screen is reserved for softkey display and is not accessible to the cursor unles the softkey display is off and LOCATE is used to get to it.

Example

10 LOCATE 1,1

Moves cursor to upper-left corner of the screen.

20 LOCATE ,,1

Makes the cursor visible; position remains unchanged.

30 LOCATE ,,,7

Position and cursor visibility remain unchanged. Sets the cursor to display at the bottom of the character starting and ending on raster line 7.

40 LOCATE 5,1,1,0,7

Moves the cursor to line 5, column 1; turns cursor on. Cursor will cover entire character cell starting at scan line 0 and ending on scan line 7.

7.79 LOF Function

Syntax LOF(<file number>)

Purpose To return the length of the named file in bytes.

Remark When a file is opened for APPEND or OUTPUT, LOF returns the size of the file, in bytes.

Example

```
110 IF REC*RECSIZ>LOF(1)
THEN PRINT "INVALID ENTRY"
```

In this example, the variables REC and RECSIZ contain the record number and record length, respectively. The calculation determines whether the specified record is beyond the end-of-file.

7.80 LOG Function

Syntax LOG(X)

Purpose To return the natural logarithm of X. X must be greater than zero.

Example PRINT LOG(45/7)

will yield

1.860752

7.81 LPOS Function

Syntax LPOS(X)

where X is the index of the printer being tested; that is LPT1: would be tested with LPOS(1), LPT2: with LPOS(2), etc.

Purpose To return the current position of the printer's print head within the printer buffer.

Remarks LPOS does not necessarily give the physical position of the print head.

Example 100 IF LPOS(X)>60 THEN LPRINT CHR$(13)

7.82 LPRINT and LPRINT USING Statements

Syntax LPRINT [<list of expressions>]

LPRINT USING <string exp>;<list of expressions>

Purpose To print data on the printer.

Remarks Same as PRINT and PRINT USING, except output goes to the line printer, and the file number option is not permitted. See Sections 7.113 and 7.114 respectively.

The line length may be changed with a WIDTH "LPT1:" statement.

Examples See Sections 7.113 and 7.114.

7.83 LSET And RSET Statements

Syntax

```
LSET <string variable>=<string expression>
RSET <string variable>=<string expression>
```

Purpose

To move data from memory to a random file buffer (in preparation for a PUT statement) or to left- or right-justify the value of a string into a string variable.

Remarks

If <string expression> requires fewer bytes than were fielded to <string variable>, LSET left-justifies the string in the field, and RSET right-justifies the string. (Spaces are used to pad the extra positions.) If the string is too long for the field, characters are dropped from the right. Numeric values must be converted to strings before they are LSET or RSET. See MKI$, MKS$, MKD$ functions, Section 7.88.

Examples

```
150 LSET A$=MKS$(AMT)
160 LSET D$=MKI$(COUNT%)
```

Note

LSET or RSET may also be used with a nonfielded string variable to left-justify or right-justify a string in a given field. For example, the program lines

```
110 A$=SPACE$(20)
120 RSET A$=N$
```

right-justify the string N$ in a 20-character field. This can be very handy for formatting printed output.

7.84 MERGE Command

Syntax MERGE<filespec>

Purpose To merge a specified file into the program currently in memory.

Remarks For merging a program not in memory, the <filespec> is an optional device specification followed by a filename or pathname that conforms to MS-DOS 2.0's rules for filenames. BASIC appends the default filename extension ".BAS" if the user specifies no extensions, and the file has been saved to the disk.

If any lines in the disk file have the same line numbers as lines in the program in memory, the lines from the file on disk will replace the corresponding lines in memory. (MERGEing may be thought of as "inserting" the program lines on disk into the program in memory.)

Microsoft GW-BASIC always returns to command level after executing a MERGE command.

Example MERGE "NUMBRS"

Inserts, by sequential line number, all lines in the program NUMBRS.BAS into the program currently in memory.

7.85 MID$ Statement

Syntax MID$(<string 1>,n [,m])=<string 2>

where n and m are integer expressions and <string exp1> and <string exp2> are string expressions.

Purpose To replace a portion of one string with another string.

Remarks The characters in <string 1>, beginning at position n, are replaced by the characters in <string 2>. The optional "m" refers to the number of characters from <string 2> that will be used in the replacement. If "m" is omitted, all of <string 2> is used. However, regardless of whether "m" is omitted or included, the replacement of characters never goes beyond the original length of <string 1>.

Example

```
10 A$="KANSAS CITY, MO"
20 MID$(A$,14)="KS"
30 PRINT A$
will yield
KANSAS CITY, KS
```

MID$ is also a function that returns a substring of a given string. See Section 7.86.

7.86 MID$ Function

Syntax

MID$(<string>,n[,m])

Purpose

To return a string of length m characters from X$, beginning with the nth character.

Remarks

n and m must be in the range 1 to 255. If m is omitted or if there are fewer than m characters to the right of the nth character, all rightmost characters beginning with the nth character are returned. If n is greater than the number of characters in <string> that is, (LEN(<string>)), MID$ returns a null string.

Example

```
10 A$="GOOD "
20 B$="MORNING EVENING AFTERNOON"
30 PRINT A$;MID$(B$,9,7)
```

will yield

```
GOOD EVENING
```

Also see the LEFT$ and RIGHT$ functions, Sections 7.68 and 7.127, respectively.

7.87 MKDIR Statement

Syntax MKDIR<pathname>

Purpose To create a new directory

Remarks <pathname> is a string expression specifying the name of the directory which is to be created. MKDIR works exactly like the MS-DOS command MKDIR. The <pathname> must be a string of less than 128 characters. (See Section 5.5, "File Handling," for a discussion of tree-structured directories).

Example Assume the current directory is the root.

MKDIR "SALES"

Creates a sub-directory named SALES in the current directory of the current drive.

MKDIR "B:USERS

Creates a sub-directory named USERS in the current directory of drive B.

Also see the CHDIR and RMDIR statements, Sections 7.11 and 7.128, respectively.

7.88 MKI$, MKS$, MKD$ Functions

Syntax

MKI$(<integer expression>)
MKS$(<single precision expression>)
MKD$(<double precision expression>)

Purpose

To convert numeric values to string values.

Remarks

Any numeric value that is placed in a random file buffer with an LSET or RSET statement must be converted to a string. MKI$ converts an integer to a 2-byte string. MKS$ converts a single precision number to a 4-byte string. MKD$ converts a double precision number to an 8-byte string.

Example

```
90 AMT=(K+T)
100 FIELD #1,8 AS D$,20 AS N$
110 LSET D$=MKS$(AMT)
120 LSET N$=A$
130 PUT #1
  .
  .
```

See also CVI, CVS, CVD Functions, Section 7.26.

7.89 NAME Statement

Syntax NAME<old filename>AS<new filename>

Purpose To change the name of a disk file.

Remarks <old filename> must exist and <new filename> must not exist; otherwise, an error will result. Also, both files must be on the same drive.

A file may not be renamed with a new drive designation. If this is attempted, a "Rename across disks" error will be generated. After a NAME command, the file exists on the same disk with the new name.

NAME may not be used to rename directories.

<old filename> must be closed before the renaming command is executed. Also, there must be one free file handle.

Examples NAME "ACCTS" AS "LEDGER"

In this example, the file that was formerly named ACCTS will now be named LEDGER.

NAME may be used to move a file from one directory to another. For example:

NAME "\X\CLIENTS" AS "\XYZ\P\CLIENTS"

7.90 NEW Command

Syntax	NEW
Purpose	To delete the program currently in memory and clear all variables.
Remarks	NEW is entered in direct mode to clear memory before entering a new program. Microsoft GW-BASIC always returns to command level after a NEW is executed. NEW closes all files and turns tracing off.
Example	NEW

7

7.91 OCT$ Function

Syntax OCT$(X)

Purpose To return a string that represents the octal value of the decimal argument. X is rounded to an integer before OCT$(X) is evaluated.

Example PRINT OCT$(24)

will yield

```
 30
```

See the HEX$ function, Section 7.56, for details on hexadecimal conversion.

7.92 ON COM Statement

Syntax

ON COM(n) GOSUB <line number>

where <line number> is the number of the first line of a subroutine that is to be performed when activity occurs on the specified communications port.

(n) is the number of the communications port.

Purpose

To specify the first line number of a subroutine to be performed when activity occurs on a communications port.

Remarks

A <line number> of zero disables the communications event trap.

The ON COM statement will only be executed if a COM(n) ON statement has been executed (see COM Statement, Section 7.20) to enable event trapping. If event trapping is enabled, and if the <line number> in the ON COM statement is not zero, GW-BASIC checks between statements to see if communications activity has occurred on the specified port. If communications activity has occurred, a GOSUB will be performed to the specified line.

If a COM OFF statement has been executed for the communications port (see COM Statement, Section 7.20), the GOSUB is not performed and is not remembered.

If a COM STOP statement has been executed for the communications port (see COM Statement, Section 7.20), the GOSUB is not performed, but will be performed as soon as a COM ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic COM STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a COM ON statement unless an explicit COM OFF was performed inside the subroutine.

The RETURN <line number> form of the RETURN statement may be used to return to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

Event trapping does not take place when GW-BASIC is not executing a program, and event trapping is automatically disabled when an error trap occurs.

7.93 ON ERROR GOTO Statement

Syntax ON ERROR GOTO <line number>

Purpose To enable error handling and specify the first line of the error handling routine.

Remarks Once error handling has been enabled, all errors detected, including direct mode errors (e.g., syntax errors), will cause a jump to the specified error handling routine. If <line number> does not exist, an "Undefined line" error results.

To disable error handling, execute an ON ERROR GOTO 0. Subsequent errors will print an error message and halt execution. An ON ERROR GOTO 0 statement that appears in an error handling routine causes Microsoft GW-BASIC to stop and print the error message for the error that caused the trap. It is recommended that all error handling routines execute an ON ERROR GOTO 0 if an error is encountered for which there is no recovery action.

Note If an error occurs during execution of an error handling routine, that error message is printed and execution terminates. Error trapping does not occur within the error handling routine.

Example 10 ON ERROR GOTO 1000

7.94 ON...GOSUB And ON...GOTO Statements

Syntax

ON<expression> GOTO<list of line numbers>

ON<expression> GOSUB<list of line numbers>

Purpose

To branch to one of several specified line numbers, depending on the value returned when an expression is evaluated.

Remarks

The value of<expression> determines which line number in the list will be used for branching. For example, if the value is three, the third line number in the list will be the destination of the branch. (If the value is a noninteger, the number is rounded.)

In the ON...GOSUB statement, each line number in the list must be the first line number of a subroutine.

It the value of<expression> is either zero or greater than the number of items in the list, control drops to the next BASIC statement.

If the value of <expression> is negative or greater than 255, an "Illegal function call" error occurs.

Example

```
100 ON L-1 GOTO 150,300,320,390
```

7.95 ON KEY Statement

Syntax

ON KEY(n) GOSUB <line number>

n is a numeric expression ranging from 1 to 20 that specifies the key to be trapped as follows:

1-10	function keys F1 to F10
11	Cursor Up
12	Cursor Left
13	Cursor Right
14	Cursor Down
15-20	keys defined by the syntax: KEY n,CHR$(s)+CHR$(t)

<line number> is the number of the first line of a subroutine that is to be performed when the specified function or cursor direction key is pressed.

Purpose

To specify the first line number of a subroutine to be performed when a specified key is pressed.

Remarks

A <line number> of zero disables the event trap.

The ON KEY statement will only be executed if a KEY(n) ON statement has been executed (see KEY(n) Statement, Section 7.66) to enable event trapping. If key trapping is enabled, and if the <line number> in the ON KEY statement is not zero, GW-BASIC checks between statements to see if the specified function, user-defined or cursor direction key has been pressed. If so, the program will branch to a subroutine specified by the GOSUB statement.

If a KEY(n) OFF statement has been executed for the specified key, (see KEY(n) Statement, Section 7.66), the GOSUB is not performed and is not remembered.

If a KEY STOP statement has been executed for the specified key, (see KEY(n) Statement, Section 7.66), the GOSUB is not performed, but will be performed as soon as a KEY(n) ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic KEY(n) STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a KEY(n) ON statement unless an explicit KEY(n) OFF was performed inside the subroutine.

The RETURN <line number> form of the RETURN statement may be used to return to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

Event trapping does not take place when GW-BASIC is not executing a program, and event trapping is automatically disabled when an error trap occurs.

The following rules apply to keys trapped by BASIC:

1. The line printer echo toggle key is processed first. Defining this key as a user defined key trap will not prevent characters from being echoed to the line printer if depressed.

2. Function keys and the cursor direction keys are examined next. Defining a function key or cursor direction key as a user defined key trap will have no effect as they are considered predefined.

3. Finally, the user defined keys are examined.

4. Any key that is trapped is not passed on. That is, the key is not read by BASIC.

WARNING

This may apply to any key, including Break or system reset (warm boot)! This is a powerful feature when you consider that it is now possible to prevent BASIC Application users from accidentally Breaking out of a program, or worse yet, rebooting the machine.

Note

When a key is trapped, that occurrence of the key is destroyed. Therefore, you cannot subsequently use the INPUT or INKEY$ statements to find out which key caused the trap. So if you wish to assign different functions to particular keys, you must set up a different subroutine for each key, rather than assigning the various functions within a single subroutine.

The ON KEY(n) statement allows 6 additional user defined KEY traps. This allows any key, control-key, shift-key, or super-shift-key to be trapped by the user as follows:

ON KEY(i) GOSUB line_number

Where: <i> is an integer expressing a legal user-defined key number.

Example

```
10 KEY 4,"SCREEN 0,0" 'assigns softkey 4
20 KEY(4) ON 'enables event trapping
.
.
70 ON KEY(4) GOSUB 200
.
.
.
key 4 pressed
.
.
.
200'Subroutine for screen
```

In the above, the programmer has overridden the normal function associated with function key 4, and replaced it with "SCREEN 0,0", which will be printed whenever that key is pressed. The value may be reassigned and it will resume its standard function when the machine is rebooted.

```
100 KEY 15, CHR$(&H04) + CHR$(83)
105 REM ** Key 15 now is Control-S **
110 KEY(15) ON
     .
     .
     .
1000 PRINT "If you want to stop processing for a
           break"
1010 PRINT "press the Control key and the 'S' at
           the"
1020 PRINT "same time."
1030 ON KEY(15) GOSUB 3000.
     .
  Operator presses Control-S
     .
3000 REM ** Suspend processing loop.
3010 CLOSE #1
3020 RESET
3030 CLS
3035 PRINT "Enter CONT to continue."
3040 STOP
3050 OPEN "A", #1, "ACCOUNTS.DAT"
3060 RETURN
```

In the above, the programmer has enable the Control-S key to enter a subroutine which closes the files and stops program execution until the operator is ready to continue.

7.96 ON PLAY Statement

Syntax

ON PLAY (n) GOSUB line number

(n) is an Integer expression in the range 1 through 32. Values outside this range will result in an "Illegal function call" error.

line number is the statement line number of the Play event trap subroutine.

Purpose

To branch to a specified subroutine when the music queue contains fewer than (n) notes. This permits continuous music during program execution.

Remarks

ON PLAY causes an event trap when the Background Music queue goes from (n) notes to (n-1) notes.

(n) must be an integer between 1 and 255.

PLAY ON	Enables Play event trapping
PLAY OFF	Disables Play event trapping
PLAY STOP	Suspends Play event trapping

If a PLAY OFF statement has been executed the GOSUB is not performed and is not remembered.

If a PLAY STOP statement has been executed the GOSUB is not performed, but will be performed as soon as a PLAY ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic PLAY STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a PLAY ON statement unless an explicit PLAY OFF was performed inside the subroutine.

The RETURN <line number> form of the RETURN statement may be used to return to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

7

Rules:

1. A play event trap is issued only when playing background music (e.g. PLAY "MB..). Play event traps are not issued when running in Music Foreground (e.g.,default case, or PLAY "MF..).

2. A play event trap is not issued if the background music queue has already gone from having (n) to (n-1) notes when a PLAY ON is executed.

3. If (n) is a large number, event traps will occur frequently enough to diminish program execution speed.

Also see PLAY ON, PLAY OFF, PLAY STOP Statements, Section 7.107.

Example

In this example control branches to a subroutine when the background music buffer decreases to 7 notes.

```
100 PLAY ON
    .
    .
540 PLAY "MB L1 XZITHER$"
550 ON PLAY(8) GOSUB 6000
    .
    .
    .
6000 REM **BACKGROUND MUSIC**
6010 LET COUNT% = COUNT% + 1
    .
    .
6999 RETURN
```

7.97 ON STRIG Statement

Syntax

ON STRIG(n) GOSUB<line number>

where (n) is the number of the joystick trigger.

where<line number>is the number of the first line of a subroutine that is to be performed when the joystick trigger is pressed.

Purpose

To specify the first line number of a subroutine to be performed when the joystick trigger is pressed.

Remarks

A<line number>of zero disables the event trap.

The ON STRIG statement will only be executed if a STRIG ON statement has been executed (see STRIG Function and STRIG Statements Sections 7.144 and 7.145) to enable event trapping. If event trapping is enabled, and if the <line number> in the ON STRIG statement is not zero, GW-BASIC checks between statements to see if the joystick trigger has been pressed. If it has, a GOSUB will be performed to the specified line.

If a STRIG OFF statement has been executed (see STRIG Statement, Section 7.145), the GOSUB is not performed and is not remembered.

If a STRIG STOP statement has been executed (see STRIG Statement, Section 7.145), the GOSUB is not performed, but will be performed as soon as a STRIG ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic STRIG STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a STRIG ON statement unless an explicit STRIG OFF was performed inside the subroutine.

The RETURN <line number> form of the RETURN statement may be used to return to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

Event trapping does not take place when GW-BASIC is not executing a program, and event trapping is automatically disabled when an error trap occurs.

7.98 ON TIMER Statement

Syntax ON TIMER (n) GOSUB<line-number>

Purpose To provide an event trap during real time.

Remarks ON TIMER causes an event trap every (n) seconds. (N) must be a numeric expression in the range of 1 to 86400 (1 second to 24 hours). Values outside this range generate and "Illegal function call" error.

The ON TIMER statement will only be executed if a TIMER ON statement has been executed to enable event trapping. If event trapping is enabled, and if the <line number> in the ON TIMER statement is not zero, GW-BASIC checks between statements to see if the time has been reached. If it has, a GOSUB will be performed to the specified line.

If a TIMER OFF statement has been executed the GOSUB is not performed and is not remembered.

If a TIMER STOP statement has been executed the GOSUB is not performed, but will be performed as soon as a TIMER ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic TIMER STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a TIMER ON statement unless an explicit TIMER OFF was performed inside the subroutine.

The RETURN <line number> form of the RETURN statement may be used to return to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

Example Display the time of day on line 1 every minute.

```
10 ON TIMER(60) GOSUB 10000
20 TIMER ON
    .
    .
    .
10000 LET OLDROW=CSRLIN 'Save current Row
10010 LET OLDCOL=POS(0) 'Save current Column
10020 LOCATE 1,1:PRINT TIME$;
10030 LOCATE OLDROW,OLDCOL 'Restore Row & Col
10040 RETURN
```

Also see TIMER ON, TIMER OFF and TIMER STOP Statements, Section 7.154.

7.99 OPEN Statement

Syntaxes

OPEN <mode1>,[#]<file number>, <filespec> [,<record length>]

OPEN <filespec> (FOR <mode2>) AS [#]<file number>[LEN=<record length>]

<filespec> is an optional device specification followed by a filename or pathname, that conforms to MS-DOS 2.0's rules for filenames.

<device> is a character device.

<mode1> is a string expression. The first character must be one of the following:

O	Specifies sequential output mode.
I	Specifies sequential input mode.
R	Specifies random input/output mode.
A	Specifies sequential output mode and sets the file pointer at the end of file and the record number as the last record of the file. A PRINT# or WRITE# statement will then extend (append) the file.

<mode2> is an expression which is one of the following:

OUTPUT	Specifies sequential output mode.
INPUT	Specifies sequential input mode.
APPEND	Specifies sequential output mode and sets the file pointer at the end of file and the record number as the last record of the file. A PRINT# or WRITE# statement will then extend (append) the file.

If <mode2> is omitted, the default random access mode is assumed. Random, however, cannot be expressed explicitly as the file mode.

<file number> is an integer expression whose value is between 1 and 255. The number is then associated with the file for as long as it is OPEN and is used to refer other disk I/O statements to the file.

<record length> is an integer expression that, if included, sets the record length for random files. GW-BASIC will ignore this option if it is used in a statement to OPEN a sequential file. The default length for records is 128 bytes, unless the command line options /I and /R have been used (See Section 2.2, "Command Line Option Switches"). The record length may not be more than the value set by the /S: switch of the BASIC command, if the /I switch is not specified.

Purpose

To allow I/O to a file or device.

Remarks

Files

A file must be opened before any I/O operation can be performed on that file. OPEN allocates a buffer for I/O to the file or device and determines the mode of access that will be used with the buffer.

OPEN allows <pathname> in place of <filespec>. If the pathname is used, and a drive is specified, the drive must be specified at the beginning of the pathname. That is, "B:\SALES\JOHN" is legal, while "\SALES\B:JOHN" is NOT legal.

The LEN= option is ignored if the file being opened has been specified as a sequential file.

Since it is possible to reference the same file in a sub-directory via different paths, it is nearly impossible for BASIC to know that it is the same file simply by looking at the path. For this reason, BASIC will not let you open the file for OUTPUT or APPEND if it is on the same disk even if the path is different. For example; if MARY is your current directory, then the following statements refer to the same file:

```
OPEN   "REPORT"   ...
OPEN   "\SALES\MARY\REPORT"...
OPEN   "..\MARY\REPORT"  ...
OPEN   "..\..\MARY\REPORT" ...
```

MS-DOS Devices

BASIC devices are:

KYBD:	LPTn:
SCRN:	CON:
COMn:	

The BASIC file I/O system allows the user to take advantage of user installed devices (See the MS-DOS manual for information on character devices).

Character devices opened are opened and used in the same manner as disk files. However, characters are not buffered by BASIC as they are for disk files. The record length is set to one.

BASIC only sends a CR (carriage return X'0D') as end of line. If the device requires a LF (line feed X'0A'), the driver must provide it.

Note

A file can be opened for sequential input or random access on more than one file number at a time. A file may be OPENed for output, however, on only one file number at a time.

Examples

```
10 OPEN "I",2,"INVEN"
```

```
10 OPEN "MAILING.DAT" FOR APPEND AS 1
```

If a user writes and installs a device called FOO, then the OPEN statement might appear as:

```
10 OPEN "\DEV\FOO" FOR OUTPUT AS #1
```

To open the printer for output, the user could use the line:

```
100 OPEN "LPT:" FOR OUTPUT AS #1
```

which uses the GW-BASIC device driver, or as part of a pathname as in:

```
100 OPEN "\DEV\LPT1" FOR OUTPUT AS #1
```

which uses the MS-DOS device driver.

7.100 OPEN COM Statement

Syntax

OPEN "COMn: [<speed>][,[<parity>]
[,[<data>][,[<stop>][,RS][,CS[n]][,DS[n]]
[,CD[n]] [,BIN] [,ASC][,LF]]]] " [FOR<mode> AS
[#]<filenumber> [LEN= <record length>]

COMn: is the name of the device to be opened.

n is the number or a legal communications device, i.e., COM1: or COM2:.

<speed> is the baud rate, in bits per second, of the device to be opened.

<parity> designates the parity of the device to be opened. Valid entries are: N (none), E (even), O (odd), S (space), or M (mark).

<data> designates the number of data bits per byte. Valid entries are: 5, 6, 7, or 8.

<stop> designates the stop bit. Valid entries are: 1, 1.5, or 2.

RS suppresses RTS (Request To Send).

CS[n] controls CTS (Clear To Send).

DS[n] controls DSR (Data Set Ready).

CD[n] controls CD (Carrier Detect).

LF specifies that a linefeed is to be sent after a carriage return. See "Remarks" for further discussion of LF.

BIN opens the device in binary mode. BIN is selected by default unless ASC is specified. See "Remarks" for further discussion of BIN.

ASC opens the device in ASCII mode. See "Remarks" for further discussion of ASC.

<mode> is one of the following string expressions:

OUTPUT Specifies sequential output mode.

INPUT Specifies sequential input mode.

If the <mode> expression is omitted, it is assumed to be random input/output. Random cannot, however, be explicitly chosen as <mode>.

<file number> is the number of the file to be opened.

Purpose

To open and initialize a communications channel for input/output.

Remarks

The OPEN COM statement must be executed before a device can be used for RS232 communication.

Any syntax errors in the OPEN COM statement will result in a "Bad File name" error.

The <speed>, <parity>, <data>, and <stop> options must be listed in the order shown in the above syntax. The remaining options may be listed in any order, but they must be listed after the <speed>, <parity>, <data>, and <stop> options.

n in the CS, DS, and CD options specifies the number of milliseconds to wait for the signal before returning a "Device Timeout" error. n can be any number from zero to 65535. If n is omitted or zero, the line status is not checked.

The defaults are n=1000 for CS and DS, and n=zero for CD. If RS is specified, the default for CS is zero.

What this means is that usually I/O statements to a communication file will fail if the CTS or DSR signals are off. The systrem will wait one second before returning a "Device Timeout" message. The CS and DS options let you ignore these lines, or specify the waiting time before the timeout.

Usually Carrier Detect (CD or RLSD) is ignored when OPEN "COM... is executed. The CD option lets you test this line by including the n argument, in the same way as CS and DS. If n is omitted or zero, then Carrier Detect is not checked (which is like omitting the CD option).

LF allows communication files to be printed on a serial line printer. When LF is specified, a linefeed character (OAH) is automatically sent after each carriage return character (OCH). This includes the carriage return sent as a result of the width setting. Note that INPUT# and LINE INPUT#, when used to read from a COM file that was opened with the LF option, stop when they see a carriage return, ignoring the linefeed.

The LF option is superseded by the BIN option.

The PE option allows parity checks. Using this parameter will yield a "Device I/O error" message for each parity error. It will also turn on the high order bit for 7 or fewer data bits. The default is no parity checks. Note that PE option has no effect on framing and overrun errors. These will always turn the high order bit on and result in a "Device I/O error".

In the BIN mode, tabs are not expanded to spaces, a carriage return is not forced at the end-of-line, and Control-Z is not treated as end-of-file. When the channel is closed, Control-Z will not be sent over the RS232 line. The BIN option supersedes the LF option.

In ASC mode, tabs are expanded, carriage returns are forced at the end-of-line, Control-Z is treated as end-of-file, and XON/XOFF protocol (if supported) is enabled. When the channel is closed, Control-Z will be sent over the RS232 line.

Examples

The following statement opens COM1: for communications as file #1 with all defaults, meaning the speed of 300 bps, even parity, and 7 data bits with one stop bit.

```
100 OPEN "COM1:" AS1
```

The following statement opens COM1: for communication at 1200 bps. Parity and numbers of data bits and stop bits will be the defaults.

```
100 OPEN "COM1:1200" AS #1
```

COM1:is opened as File 1 for asynchronous I/O at 600 bps, with no parity produced or checked, 8-bit bytes sent and received, and 1 stop bit transmitted.

```
100 OPEN "COM1:600,N,8" AS #1
```

The next opens COM1: at 1800 bps with no parity, eight data bits, and CS, DS, and CD being checked.

```
10 OPEN "COM1:1800,N,8,,CS,DS,CD" AS #1
```

The following statement opens COM1: at 600 bps with the defaults of even parity and seven data bits and with parity checking. RTS is sent, and Device Timeout is given if DSR is not seen within five seconds.

```
50 OPEN "COM1:600,,,,CS,DS5000,PE" AS #1
```

Note that the commas are used to indicate the position of the positional arguments parity, start, and stop, even though values for them are not specified.

An OPEN statement can be used with an ON ERROR statement to make certain that a modem is working properly before sending any data. For instance, the following program makes sure of a Carrier Detect (CD or RLSD) from the modem before beginning. Line 200 is is set to timeout after waiting 10 seconds. TIMES is set to 3 so we give up if Carrier Detect is not seen within half a minute. Once communication is established, the file is reopened with a shorter wait until timeout.

7

```
50 TIMES=6
100 ON ERROR GOTO 900
200 OPEN "COM1:1200,N,8,2,CS,DS,CD10000" AS #2
300 ON ERROR GOTO 0
400 CLOSE #2' to continue
500 GOTO 2000
.
900 IF ERR=24 THEN GOTO 920
910 ON ERROR GOTO 0
920 TIMES=TIMES-1
930 IF TIMES=0 THEN ON ERROR GOTO 0' forget it
940 RESUME
.
.
.
2000 OPEN "COM1:1200,N,8,2,CS,DS,CD5000" AS #1
```

The last example shows a typical way of using communication file to control a serial line printer. The LF argument in the OPEN statement ensures that lines are not printed on top of each other.

```
100 WIDTH "COM1:", 132
200 OPEN "COM1:300,N,8,,CS10000,DS10000,CD10000,
LF" AS #1
```

7.101 OPTION BASE Statement

Syntax

OPTION BASE n

where n is 1 or 0

Purpose

To declare the minimum value for array subscripts.

Remarks

The default base is 0. If the statement

OPTION BASE 1

is executed, the lowest value an array subscript may have is 1.

The OPTION BASE statement must be coded before you define or use any arrays.

Chained programs may have an OPTION BASE statement if no arrays are passed between them or the specified base is identical in the chained programs. The chained program will inherit the OPTION BASE value of the chaining program.

Example

```
10 OPTION BASE 1
```

7.102 OUT Statement

Syntax OUT I,J

where I is the port number. It must be an integer expression in the range 0 to 65535.

J is the data to be transmitted. It must be an integer expression in the range 0 to 255.

Purpose To send a byte to a machine output port.

Example

```
100 OUT 12345,255
```

In 8086 assembly language, this is equivalent to:

```
MOV DX,12345
MOV AL,255
OUT DX,AL
```

7.103 PAINT Statement

Syntax

PAINT (<x>,<y>)[,<paint attribute>
[,<border color>] [,background attribute]]

(<xstart> and <ystart>) are the coordinates where painting is to begin. Painting should always start on a non-border point. If painting starts within a border, the bordered figure is painted. If painting starts outside a bordered figure, the background is painted.

If the <paint attribute> is a string expression PAINT will execute "Tiling", a process similar to "Line-styling". Like LINE, PAINT looks at a "tiling" mask each time a point is put down on the screen.

If <paint attribute> is a numeric expression, then the number must be a valid color and is used to paint the area as before. (see COLOR Statement, Section 7.19). If the <paint attribute> is not specified, the foreground color will be used.

<border color> identifies the border color of the figure to be filled. When the border color is encountered, painting of the current line will stop. If the border color is not specified, the <paint attribute> will be used.

<background attribute> is a string formula returning character data. When it is omitted, the default is CHR$(0).

When specified, <background attribute> gives the "background tile slice" to skip when checking for termination of the boundary. Painting is terminated when adjacent points display the paint color; specifying a background tile slice allows the user to paint over an already painted area without terminating the process because two consecutive lines with the same paint attributes are encountered.

Purpose To fill a graphics area with the color or pattern specified.

Remarks Painting is complete when a line is painted without changing the color of any pixel; i.e., the entire line is equal to the paint color.

The PAINT command can be used to fill any figure, but painting complex figures may result in an "Out of Memory" error. If this happens, the CLEAR statement may be given to increase the amount of stack space available.

The PAINT command permits coordinates outside the screen or viewport.

Tiling

Tiling is the design of a PAINT pattern that is 8 bits wide and up to 64 bytes long. Each byte in the Tile String masks 8 bits along the x axis when putting down points. Construction of this Tile mask works as follows:

Use the syntax PAINT (x,y), CHR$(n)...CHR$(n) where (n) is a number between 0 and 255 which will be represented in binary across the x-axis of the "tile". Each CHR$(n) up to 64 will generate an image not of the assigned character, but of the bit arrangement of the code for that character. For example, the decimal number 85 is binary "01010101"; the graphic image line on a black and white screen generated by CHR$(85) is an eight pixel line, with even numbered points turned white, and odd ones black. That is, each bit containing a "1" will be set the associated pixel on and each bit filled with a "0" will set the associated bit off in a black and white system. The ASCII character CHR$(85), which is "U", is not displayed in this case.

If the current screen mode supports only two colors, then the screen can be painted with 'X's with the following statement.

```
PAINT (320,100),CHR$(129)+CHR$(66)
+CHR$(36)+CHR$(24)+ CHR$(24)+CHR$(36)+
CHR$(66)+CHR$(129)
```

This appears on the screen as:

```
      x increases -->
0,0 |x|  |  |  |  |  |  |x|  CHR$(129)  Tile byte 1
0,1 |  |x|  |  |  |  |x|  |  CHR$(66)   Tile byte 2
0,2 |  |  |x|  |  |x|  |  |  CHR$(36)   Tile byte 3
0,3 |  |  |  |x|x|  |  |  |  CHR$(24)   Tile byte 4
0,4 |  |  |  |x|x|  |  |  |  CHR$(24)   Tile byte 5
0,5 |  |  |x|  |  |x|  |  |  CHR$(36)   Tile byte 6
0,6 |  |x|  |  |  |  |x|  |  CHR$(66)   Tile byte 7
0,7 |x|  |  |  |  |  |  |x|  CHR$(129)  Tile byte 8
```

When supplied, <backgroundattr> specifies the "background tile slice" to skip when checking for boundary termination.

You cannot specify more than two consecutive bytes in the tile background slice that match the tile string. Specifying more than two will result in an "Illegal function call" error.

Example

```
10 PAINT (5,15),2,0
```

begins painting at coordinates 5,15 with color 2 and border color 0, and fills to a border.

7.104 PEEK Function

Syntax PEEK(I)

Purpose To return the byte read from the indicated memory location (I).

Remarks The returned value is an integer in the range 0 to 255. I must be in the range -32768 to 65535. I is the offset from the current segment, which was defined by the last DEF SEG statement (see Section 7.32). For the interpretation of a negative value of I, see VARPTR Function, Section 7.158.

PEEK is the complementary function of the POKE statement.

Example A=PEEK(&H5A00)

In this example, the value at the location with the hex address 5A00 is loaded into a variable, A.

7.105 PLAY Statement

Syntax PLAY <string>

Purpose To play music as specified by <string>.

Remarks PLAY uses a concept similar to that in DRAW (see Section 7.36) by embedding a Music Macro Language into one statement. A set of subcommands, used as part of the PLAY statement, specifies the particular action to be taken.

Prefixes-ChangeOctave

>	Increments octave. Octave will not advance beyond 6.
<	Decrements octave. Octave will not drop below 0.

Tone

O <n>	Sets the current octave. There are seven octaves, numbered 0 through 6.
A-G	Plays a note in the range A-G. # or + after the note specifies sharp; - specifies flat.
N <n>	Plays note n. n may range from 0 through 84 (in the 7 possible octaves, there are 84 notes). n = 0 means a rest.

Duration

L <n>	Sets the length of each note. L 4 is a quarter note, L 1 is a whole note, etc. n may be in the range 1 through 64. The length may also follow the note when a change of length only is desired for a particular note. In this case, A 16 is equivalent to L 16 A.
MN	Sets "music normal" so that each note will play 7/8 of the time determined by the length (L).

ML	Sets "music legato" so that each note will play the full period set by length (L).
MS	Sets "music staccato" so that each note will play 3/4 of the time determined by the length (L).

Tempo

P<n>	Specifies a pause, ranging from 1 through 64. This option corresponds to the length of each note, set with L<n>.
T<n>	Sets the "tempo," or the number of L 4's in one minute. n may range from 32 through 255. The default is 120.

Operation

MF	Sets music (PLAY statement) and SOUND to run in the foreground. That is, each subsequent note or sound will not start until the previous note or sound has finished. This is the default setting.
MB	Music (PLAY statement) and SOUND are set to run in the background. That is, each note or sound is placed in a buffer allowing the GW-BASIC program to continue executing while the note or sound plays in the background. The number of notes that can be played in the background at one time varies according to the particular machine.

Substring

X<string>	Executes a substring. Because of the slow clock interrupt rate, some notes will not play at higher tempos (L 64 at T 255, for example). Note (as shown in the "Examples" below) that a substring may be executed by appending the character form of the substring address to "X".

Suffixes

or + Follows a specified note, and turns it into a sharp.

Follows a specified note, and turns it into a flat.

A period after a note causes the note to play 3/2 times the length determined by L multiplied by T (tempo). Multiple periods may appear after a note. The period is scaled accordingly; for example, A. is 3/2, A.. is 9/4, A... is 27/8, etc. Periods may appear after a pause (P). In this case, the pause length may be scaled in the same way notes are scaled.

Examples

```
PLAY "<<" 'Decrement by two octaves

PLAY ">" 'Increment by an octave

PLAY ">A" 'Increment by an octave and play an A note

PLAY "XSONG$"


LET LISTEN$ = "T180 O2 P2 P8 L8 GGG L2 E-"

LET FATE$ = "P24 P8 L8 FFF L2 D"

PLAY LISTEN$ + FATE$
```

This example will play the beginning of the first movement of Beethoven's Fifth Symphony.

7.106 PLAY Function

Syntax PLAY(n)

(n) is a dummy argument and may be any value.

Purpose To return the number of notes currently in the background music queue.

Remarks PLAY(n) will return 0 when the user is in Music Foreground Mode. Since the music buffer can hold up 47 notes, 47 is the maximum value that can be returned.

7.107 PLAY ON, PLAY OFF, PLAY STOP Statements

Syntax

```
PLAY ON
PLAY OFF
PLAY STOP
```

Purpose

PLAY ON enables play event trapping.
PLAY OFF disables play event trapping.
PLAY STOP suspends play event trapping.

Remarks

If a PLAY OFF statement has been executed the GOSUB is not performed and is not remembered.

If a PLAY STOP statement has been executed the GOSUB is not performed, but will be performed as soon as a PLAY ON statement is executed.

When an event trap occurs (i.e., the GOSUB is performed), an automatic PLAY STOP is executed so that recursive traps cannot take place. The RETURN from the trapping subroutine will automatically perform a PLAY ON statement unless an explicit PLAY OFF was performed inside the subroutine.

The RETURN <line number> form of the RETURN statement may be used to return to a specific line number from the trapping subroutine. Use this type of return with care, however, because any other GOSUBs, WHILEs, or FORs that were active at the time of the trap will remain active, and errors such as "FOR without NEXT" may result.

7.108 PMAP Function

Syntax PMAP <expression>, <function>

Purpose To map world coordinate expressions to physical locations or to map physical expressions to a world coordinate location.

<function> =

0 Maps world expression to physical x coordinate.

1 Maps world expression to physical y coordinate.

2 Maps physical expression to world x coordinate.

3 Maps physical expression to world y coordinate.

Remarks The four PMAP functions allow the user to find equivalent point locations between the world coordinates created with the WINDOW statement and the physical coordinate system of the screen or view-port as defined by the VIEW statement.

Examples If a user had defined a WINDOW SCREEN (80,100) - (200,200) then the upper left coordinate of the window would be (80,100) and the lower right would be (200,200). The screen coordinates may be (0,0) in the upper left hand corner and (639,199) in the lower right. Then:

```
X = PMAP(80,0)
```

would return the screen x coordinate of the window x coordinate 80:

```
0
```

The PMAP function in the statement:

```
Y = PMAP(200,1)
```

would return the screen y coordinate of the window y coordinate 200:

```
199
```

The PMAP function in the statement:

```
X = PMAP(619,2)
```

would return the "world" x coordinate that corresponds to the screen or viewport x coordinate 619:

```
199
```

The PMAP function in the statement:

```
Y = PMAP(100,3)
```

would return the "world" y coordinate that corresponds to the screen or viewport y coordinate 100:

```
140
```

7.109 POINT Function

Syntax

POINT (<xcoordinate>,<ycoordinate>)

<xcoordinate> and <ycoordinate> are the coordinates of the pixel that is to be referenced.

or

POINT (<function>)

Purpose

POINT (x,y) allows the user to read the color number of a pixel from the screen. If the specified point is out of range, the value -1 is returned.

POINT with one argument allows the user to retrieve the current Graphics cursor coordinates. Therefore:

x= POINT(funct) Returns the value of the current x or y Graphics accumulator as follows:

function =

0 Returns the current physical x coordinate.

1 Returns the current physical y coordinate.

2 Returns the current logical x coordinate. If the WINDOW statement has not been used, this will return the same value as the POINT(0) function.

3 Returns the current logical y coordinate if WINDOW is active, else returns the current physical y coordinate as in 1 above.

where the physical coordinate is the coordinate on the screen or current viewport.

Examples

```
10 SCREEN 1
20 LET C=3
30 PSET (10,10),C
40 IF POINT(10,10)=C THEN PRINT "This  point  is
color ";C
```

```
5  SCREEN 2
10 IF POINT(i,i)<>0 THEN PRESET (i,i)
   ELSE PSET (i,i)
   'invert current state of a point
20 PSET (i,i),1-POINT(i,i) 'another way
   to invert a point if the system is black  and
   white.
```

7.110 POKE Statement

Syntax POKE I,J

where I and J are integer expressions.

Purpose To write a byte into a memory location.

Remarks I and J are integer expressions. The expression I represents the address of the memory location and J is the data byte. J must be in the range 0 to 255.

I must be in the range -32768 to 65535. I is the offset from the current segment, which was set by the last DEF SEG statement (see Section 7.32). For interpretation of negative values of I, see VARPTR Function, Section 7.158.

The complementary function to POKE is PEEK. (See Section 7.104.)

WARNING

Use POKE carefully. If it is used incorrectly, it can cause GW-BASIC or MS-DOS to crash.

Example

```
10 POKE &H5A00,&HFF
```

7.111 POS Function

Syntax POS(I)

Purpose To return the current horizontal (column) position of the cursor.

Remarks The leftmost position is 1. I is a dummy argument. To return the current vertical line position of the cursor, use the CSRLIN function (Section 7.25).

Example IF POS(X)>60 THEN BEEP

Also see LPOS Function, Section 7.81.

7.112 PRESET Statement

Syntax

PRESET [STEP](<xcoordinate>,<ycoordinate>)
[,<color>]

<xcoordinate> and <ycoordinate> specify the pixel that is to be set.

<color> is the color number that is to be used for the specified point.

The STEP option, when used, indicates the given x and y coordinates will be relative, not absolute. That means the x and y are distances from the most recent cursor location, not distances from the (0,0) screen coordinate.

Purpose

To draw a specified point on the screen. PRESET works exactly like PSET except that if the <color> is not specified, the background color is selected.

Remarks

If a coordinate is outside the current viewport, no action is taken, nor is an error message given.

Coordinates can be shown as absolutes, as in the above syntax, or the STEP option can be used to reference a point relative to the most recent point used. For example, if the most recent point referenced were (10,10), STEP (10,5) would reference the point at (20,15).

Example

```
5 REM DRAW A LINE FROM (0,0) TO (100,100)
10 FOR i=0 TO 100
20 PRESET (i,i),1
30 NEXT

35 REM NOW ERASE THAT LINE
40 FOR i=0 TO 100
50 PRESET STEP (-1,-1)
60 NEXT
```

This example draws a line from (0,0) to (100,100) and then erases that line by overwriting it with the background color.

7.113 PRINT Statement

Syntax PRINT [<list of expressions>]

Purpose To output data on the screen.

Remarks If <list of expressions> is omitted, a blank line is printed. If <list of expressions> is included, the values of the expressions are printed on the screen. The expressions in the list may be numeric and/or string expressions. (String literals must be enclosed in quotation marks.)

A question mark (?) can be used as a form of shorthand by the user. It will be interpreted as the word "PRINT", and will appear as "PRINT" in subsequent listings.

Print Positions

The position of each printed item is determined by the punctuation used to separate the items in the list. Microsoft GW-BASIC divides the line into print zones of 14 spaces each. In the list of expressions, a comma causes the next value to be printed at the beginning of the next zone. semicolon causes the next value to be printed immediately after the last value. Typing one or more spaces between expressions has the same effect as typing a semicolon.

If a comma or a semicolon terminates the list of expressions, the next PRINT statement begins printing on the same line, spacing according to instructions. If the list of expressions terminates without a comma or a semicolon, a carriage return is printed at the end of the line. If the printed line is wider than the screen width, Microsoft GW-BASIC goes to the next physical line and continues printing.

Printed numbers are always followed by a space. Positive numbers are preceded by a space. Negative numbers are preceded by a minus sign. Single precision numbers that can be represented with 6 or fewer digits in the unscaled format no less accurately than they can be represented in the scaled format, are output using the unscaled format. For example, 1E-7 is output as .0000001 and 1E-8 is output as 1E-08. Double precision numbers that can be represented with 16 or fewer digits in the unscaled format no less accurately than they can be represented in the scaled format, are output using the unscaled format. For example, 1D-15 is output as .0000000000000001 and 1D-16 is output as 1D-16.

With the interpreter, a question mark may be used in place of the word PRINT in a PRINT statement.

Example 1

```
10 X=5
20 PRINT X+5,X-5,X*(-5),X^5
30 END
```

will yield

```
10            0            -25            3125
```

In this example, the commas in the PRINT statement cause each value to be printed at the beginning of the next print zone.

Example 2

```
10 INPUT X
20 PRINT X "SQUARED IS" X^2 "AND";
30 PRINT X "CUBED IS" X^3
40 PRINT
50 GOTO 10
```

will yield

```
? 9
 9 SQUARED IS 81 AND 9 CUBED IS 729

? 21
 21 SQUARED IS 441 AND 21 CUBED IS 9261

?
```

In this example, the semicolon at the end of line 20 causes both PRINT statements to be printed on the same line. Line 40 causes a blank line to be printed before the next prompt.

Example 3

```
10 FOR X=1 TO 5
20 J=J+5
30 K=K+10
40 ?J;K;
50 NEXT X
```

will yield

```
5  10  10  20  15  30  20  40  25  50
```

In this example, the semicolons in the PRINT statement cause each value to be printed immediately after the preceding value. (Remember, a number is always followed by a space, and positive numbers are preceded by a space.) In line 40, a question mark is used instead of the word PRINT.

7.114 PRINT USING Statement

Syntax — PRINT USING <string exp>;<list of expressions>

Purpose — To print strings or numbers using a specified format.

Remarks/ Examples — <list of expressions> is comprised of the string expressions or numeric expressions that are to be printed, separated by semicolons.

<string exp> is a string literal (or variable) composed of special formatting characters. These formatting characters (see below) determine the field and the format of the printed strings or numbers.

String Fields

When PRINT USING is used to print strings, one of three formatting characters may be used to format the string field:

"!" — Specifies that only the first character in the given string is to be printed.

"\n\spaces"

Specifies that 2 + n characters from the string are to be printed. If the backslashes are typed with no spaces, two characters will be printed; with one space, three characters will be printed, and so on. If the string is longer than the field, the extra characters are ignored. If the field is longer than the string, the string will be left-justified in the field and padded with spaces on the right.

Example:

```
10 A$="LOOK":B$="OUT"
30 PRINT USING "!";A$;B$
40 PRINT USING "\  \";A$;B$
50 PRINT USING " \  \";A$;B$;"!!"
```

will yield

```
LO
LOOKOUT
LOOK OUT  !!
```

"&" Specifies a variable length string field. When the field is specified with "&", the string is output without modification.

Example:

```
10 A$="LOOK":B$="OUT"
20 PRINT USING "!";A$;
30 PRINT USING "&";B$
```

will yield

```
LOUT
```


Numeric Fields

When PRINT USING is used to print numbers, the following special characters may be used to format the numeric field:

A number sign is used to represent each digit position. Digit positions are always filled. If the number to be printed has fewer digits than positions specified, the number will be right-justified (preceded by spaces) in the field.

A decimal point may be inserted at any position in the field. If the format string specifies that a digit is to precede the decimal point, the digit will always be printed (as 0, if necessary). Numbers are rounded as necessary.

```
PRINT USING "##.##";.78
0.78

PRINT USING "###.##";987.654
987.65

PRINT USING "##.##   ";10.2,5.3,66.789,.234
10.20    5.30    66.79    0.23
```

In the last example, three spaces were inserted at the end of the format string to separate the printed values on the line.

\+ A plus sign at the beginning or end of the format string will cause the sign of the number (plus or minus) to be printed before or after the number.

- A minus sign at the end of the format field will cause negative numbers to be printed with a trailing minus sign.

```
PRINT USING "+##.##   ";-68.95,2.4,55.6,-.9
-68.95    +2.40   +55.60    -0.90

PRINT USING "##.##-   ";-68.95,22.449,-7.01
68.95-    22.45     7.01-
```

** A double asterisk at the beginning of the format string causes leading spaces in the numeric field to be filled with asterisks. The ** also specifies positions for two more digits.

```
PRINT USING "**#.#   ";12.39,-0.9,765.1
*12.4   *-0.9   765.1
```

$$ A double dollar sign causes a dollar sign to be printed to the immediate left of the formatted number. The $$ specifies two more digit positions, one of which is the dollar sign. The exponential format cannot be used with $$. Negative numbers cannot be used unless the minus sign trails to the right.

```
PRINT USING "$$###.##";456.78
$456.78
```

**$ The **$ at the beginning of a format string combines the effects of the above two symbols. Leading spaces will be asterisk-filled and a dollar sign will be printed before the number. **$ specifies three more digit positions, one of which is the dollar sign.

The exponential format cannot be used with **$. When negative numbers are printed, the minus sign will appear immediately to the left of the dollar sign.

```
PRINT USING "**$##.##";2.34
***$2.34
```

A comma that is to the left of the decimal point in a formatting string causes a comma to be printed to the left of every third digit to the left of the decimal point. A comma that is at the end of the format string is printed as part of the string. A comma specifies another digit position. The comma has no effect if used with exponential (^^^^) format.

```
PRINT USING "####,.##";1234.5
1,234.50

PRINT USING "####.##,";1234.5
1234.50,
```

^^^^ Four carets (or up-arrows) may be placed after the digit position characters to specify exponential format. The four carets allow space for E+xx to be printed. Any decimal point position may be specified. The significant digits are left-justified, and the exponent is adjusted. Unless a leading + or trailing + or - is specified, one digit position will be used to the left of the decimal point to print a space or a minus sign.

```
PRINT USING "##.##^^^^";234.56
2.35E+02

PRINT USING ".####^^^^-";-888888
-.8889E+06

PRINT USING "+.##^^^^";123
+.12E+03
```

_ An underscore in the format string causes the next character to be output as a literal character.

```
PRINT USING "_!##.##!";12.34
!12.34!
```

The literal character itself may be an underscore by placing "__" in the format string.

% If the number to be printed is larger than the specified numeric field, a percent sign is printed in front of the number. If rounding causes the number to exceed the field, a percent sign will be printed in front of the rounded number.

```
PRINT USING "##.##";111.22
%111.22

PRINT USING ".##";.999
%1.00
```

If the number of digits specified exceeds 24, an "Illegal function call" error will result.

7.115 PRINT# and PRINT# USING Statements

Syntax

PRINT#<file number>,[USING <string exp>;]
<list of expressions>

Purpose

To write data to a sequential file.

Remarks/ Examples

<file number> is the number used when the file was opened for output. <string exp> consists of formatting characters as described in "PRINT USING Statement," Section 7.114. The expressions in <list of expressions> are the numeric and/or string expressions that will be written to the file.

PRINT# does not compress data. An image of the data is written to the file, just as it would be displayed on the terminal screen with a PRINT statement. For this reason, care should be taken to delimit the data, so that it will be input correctly.

In the list of expressions, numeric expressions should be delimited by semicolons. For example:

```
PRINT#1,A;B;C;X;Y;Z
```

(If commas are used as delimiters, the extra blanks that are inserted between print fields will also be written to the file.)

String expressions must be separated by semicolons in the list. To format the string expressions correctly in the file, use explicit delimiters in the list of expressions.

For example, let A$="CAMERA" and B$="93604-1". The statement

```
PRINT#1,A$;B$
```

would write CAMERA93604-1 to the file. Because there are no delimiters, this could not be input as two separate strings. To correct the problem, insert explicit delimiters into the PRINT# statement as follows:

```
PRINT#1,A$;",";B$
```

The image written to the file is

```
CAMERA,93604-1
```

which can be read back into two string variables.

If the strings themselves contain commas, semicolons, significant leading blanks, carriage returns, or linefeeds, write them to the file surrounded by explicit quotation marks, CHR$(34).

For example, let A$="CAMERA, AUTOMATIC" and B$=" 93604-1". The statement

```
PRINT#1,A$;B$
```

would write the following image to file:

```
CAMERA, AUTOMATIC   93604-1
```

And the statement

```
INPUT#1,A$,B$
```

would input "CAMERA" to A$ and "AUTOMATIC 93604-1" to B$. To separate these strings properly in the file, write double quotation marks to the file image using CHR$(34). The statement

```
PRINT#1,CHR$(34);A$;CHR$(34);CHR$(34);B$
;CHR$(34)
```

writes the following image to the file:

```
"CAMERA, AUTOMATIC""   93604-1"
```

And the statement

```
INPUT#1,A$,B$
```

would input "CAMERA, AUTOMATIC" to A$ and "93604-1" to B$.

The PRINT# statement may also be used with the USING option to control the format of the file. For example:

```
PRINT#1,USING"$$###.##,";J;K;L
```

Note   See also WRITE# Statement, Section 7.167.

7.116 PSET Statement

Syntax

PSET [STEP](<xcoordinate>,<ycoordinate>) [,<color>]

(<xcoordinate> and <ycoordinate>) specify the point on the screen to be colored.

<color> is the number of the color to be used.

The STEP option, when used, indicates the given x and y coordinates will be relative, not absolute. That means the x and y are distances from the most recent cursor location, not distances from the (0,0) screen coordinate.

Remarks

When GW-BASIC scans coordinate values, it will allow them to be beyond the edge of the screen (size of the screen is dependent on the particular machine being used, and can be adjusted with the WIDTH statement). However, values outside the integer range -32768 to 32767 will cause an "Overflow" error.

Coordinates can be shown as offsets by using the STEP option to reference a point relative to the most recent point used. The syntax of the STEP option is:

STEP (<xoffset>,<yoffset>)

For example, if the most recent point referenced were (0,0), PSET STEP (10,0) would reference a point at offset 10 from x and offset 0 from y.

The coordinate (0,0) is always the upper left corner of the screen.

PSET allows the <color> to be left off the command line. If it is omitted, the default is the foreground color.

Example

```
 5 REM DRAW A LINE FROM (0,0) TO (100,100)
10 FOR I=0 TO 100
20   PSET (I,I)
30 NEXT I

35 REM NOW ERASE THAT LINE
40 FOR I=0 TO 100
50   PSET STEP (-1,-1),0
60 NEXT I
```

This example draws a line from (0,0) to (100,100) and then erases that line by writing over it with the background color.

7.117 PUT Statement - File I/O

Syntax PUT [#]<file number>[,<record number>]

Purpose To write a record from a random buffer to a random access file.

Remarks <file number> is the number under which the file was opened. If record number is omitted, the record will assume the next available record number (after the last PUT or GET). The largest possible record number is 32767. The smallest record number is 1.

The GET and PUT statements allow fixed-length input and output for GW-BASIC COM files. However, because of the low performance associated with telephone line communications, we recommend that you do not use GET and PUT for telephone communication.

Note LSET, RSET, PRINT#, PRINT# USING, and WRITE# may be used to put characters in the random file buffer before executing a PUT statement.

In the case of WRITE#, Microsoft GW-BASIC pads the buffer with spaces up to the carriage return. Any attempt to read or write past the end of the buffer causes a "Field overflow" error.

For details on file I/O, see Chapter 5, "Working with Files and Devices."

Example

```
100 PUT  1, A$, B$, C$
```

7.118 PUT Statement - Graphics

Syntax PUT (x1,y1),<array name>[,action verb]

used with

GET (x1,y1)-(x2,y2),<array name>

(x1,y1) in the PUT statement specifies the point where a stored image is to be displayed on the screen. The specified point is the coordinate of the top left corner of the image. If the image to be transferred is too large to fit in the current viewport, an "Illegal function call" error will result.

<action verb> is one of: PSET, PRESET, AND, OR, XOR.

PSET transfers the data point by point onto the screen. Each point has the exact color attribute it had when it was taken from the screen with a GET.

PRESET is the same as PSET except that a negative image (black on white) is produced.

AND is used when the image is to be transferred over an existing image on the screen. The resulting image is the product of the logical AND expression; points that had the same color in both the existing image and the PUT image will remain the same color, points that do not have the same color in both the existing image and the PUT image, will not.

OR is used to superimpose the image onto an existing image.

XOR is a special mode often used for animation. It causes the points on the screen to be inverted where a point exists in the array image. This behavior is exactly like that of the cursor. When an image is PUT against a complex background twice, the background is restored unchanged. This allows a user to move an object around the screen without erasing the background.

The default <action verb> is XOR.

Purpose

The GET and PUT statements are used together to transfer graphic images to and from the screen.

The GET statement transfers the screen image bounded by the rectangle described by the specified points into the array.

The PUT statement transfers the image stored in the array onto the screen.

The <action verb> specifies the interaction between the stored image and the one already on the screen.

Remarks

One of the most useful things that can be done with GET and PUT is animation. Animation is performed as follows:

1. PUT the object(s) on the screen.
2. Recalculate the new position of the object(s).
3. PUT the object(s) on the screen a second time at the old location(s) (using XOR) to remove the old image(s).
4. Go to step 1, but this time PUT the object(s) at the new location.

Movement done this way will leave the background unchanged. Flicker can be cut down by minimizing the time between steps 4 and 1 and by making sure that there is enough time delay between 1 and 3. If more than one object is being animated, every object should be processed at once, one step at a time.

If it is not important to preserve the background, animation can be performed using the PSET action verb. The idea is to leave a border around the image when it is first gotten that is as large or larger than the maximum distance the object will move. Thus, when an object is moved, this border will effectively erase any points left by the previous PUT. This method may be somewhat faster than the method using XOR described above, since only one PUT is required to move an object (although you must PUT a larger image).

It is possible to examine the x and y dimensions and even the data itself if an integer array is used. With the interpreter, the x dimension is in element 0 of the array, and the y dimension is found in element 1. (However, this will not always be true for the compiler.) Remember that integers are stored low byte first, then high byte, but the data is transferred high byte first (leftmost) and then low byte.

7.119 RANDOMIZE Statement

Syntax — RANDOMIZE [<expression>]

Purpose — To reseed the random number generator.

Remarks — If <expression> is omitted, Microsoft GW-BASIC suspends program execution and asks for a value by printing

Random Number Seed (-32768 to 32767)?

before executing RANDOMIZE.

If <expression> is a variable, the value of that variable is used to seed the random numbers.

If expression is the word "TIMER" then the TIMER function is used to pass a random number seed.

If the random number generator is not reseeded, the RND function returns the same sequence of random numbers each time the program is run. To change the sequence of random numbers every time the program is run, place a RANDOMIZE statement at the beginning of the program and change the argument with each run.

Example

```
10 RANDOMIZE
20 FOR I=1 TO 5
30 PRINT RND;
40 NEXT I
```

will yield

Random Number Seed (-32768 to 32767)? 3
(user types 3)

will yield

.885982 .4845668 .586328 .1194246 .7039225

```
Random Number Seed (-32768 to 32767)? 4
(user types 4 for new sequence)
```

will yield

```
.803506  .1625462  .929364  .2924443  .322921
```

```
Random Number Seed (-32768 to 32767)? 3
(same sequence as first run)
```

will yield

```
.885982  .4845668  .586328  .1194246  .7039225
```

Note that the numbers your program produces may not be the same as the ones shown here.

7.120 READ Statement

Syntax READ <list of variables>

Purpose To read values from a DATA statement and assign them to variables. (See "DATA Statement," Section 7.27.)

Remarks A READ statement must always be used in conjunction with a DATA statement. READ statements assign variables to DATA statement values on a one-to-one basis. READ statement variables may be numeric or string, and the values read must agree with the variable types specified. If they do not agree, a "Syntax error" will result.

A single READ statement may access one or more DATA statements (they will be accessed in order), or several READ statements may access the same DATA statement. If the number of variables in <list of variables> exceeds the number of elements in the DATA statement(s), an "Out of data" error message is printed. If the number of variables specified is fewer than the number of elements in the DATA statement(s), subsequent READ statements will begin reading data at the first unread element. If there are no subsequent READ statements, the extra data is ignored.

To reread DATA statements from the start, use the RESTORE statement (see RESTORE Statement, Section 7.124)

Example 1

```
.
.
.
80 FOR I=1 TO 10
90 READ A(I)
100 NEXT I
110 DATA 3.08,5.19,3.12,3.98,4.24
120 DATA 5.08,5.55,4.00,3.16,3.37
.
.
.
```

This program segment READs the values from the DATA statements into the array A. After execution, the value of A(1) will be 3.08, and so on.

Example

```
10 PRINT "CITY", "STATE", " ZIP"
20 READ C$,S$,Z$
30 DATA "DENVER,", "COLORADO","80211"
40 PRINT C$,S$,Z$
```

will yield

```
CITY          STATE          ZIP
DENVER,       COLORADO       80211
```

This program reads string and numeric data from the DATA statement in line 30.

7.121 REM Statement

Syntax REM<remark>

Purpose To allow explanatory remarks to be inserted in a program.

Remarks REM statements are not executed but are output exactly as entered when the program is listed.

REM statements may be branched into from a GOTO or GOSUB statement. Execution will continue with the first executable statement after the REM statement.

Remarks may be added to the end of a line by preceding the remark with a single quotation mark instead of :REM.

Important Do not use the single quotation form of the REM statement in a data statement, because it would be considered legal data.

Example

```
.
.
.
120 REM CALCULATE AVERAGE VELOCITY
130 FOR I=1 TO 20
140 SUM=SUM + V(I)
.
.
.
```

or

```
.
.
.
120 FOR I=1 TO 20    'CALCULATE AVERAGE VELOCITY
130 SUM=SUM+V(I)
140 NEXT I
.
.
.
```

7.122 RENUM Command

Syntax RENUM [[<new number>][,[<old number>][,<increment>]]]

Purpose To renumber program lines.

Remarks <new number> is the first line number to be used in the new sequence. The default is 10. <old number> is the line in the current program where renumbering is to begin. The default is the first line of the program. <increment> is the increment to be used in the new sequence. The default is 10.

RENUM also changes all line number references following GOTO, GOSUB, THEN, ON...GOTO, ON...GOSUB, and ERL statements to reflect the new line numbers. If a nonexistent line number appears after one of these statements, the error message "Undefined line number in xxxxx" is printed. The incorrect line number reference is not changed by RENUM, but line number yyyyy may be changed.

Note RENUM cannot be used to change the order of program lines (for example, RENUM 15,30 when the program has three lines numbered 10, 20 and 30) or to create line numbers greater than 65529. An "Illegal function call" error will result.

Examples

RENUM	Renumbers the entire program. The first new line number will be 10. Lines will be numbered in increments of 10.
RENUM 300,,50	Renumbers the entire program. The first new line number will be 300. Lines will be numbered in increments of 50.
RENUM 1000,900,20	Renumbers the lines from 900 up so they start with line number 1000 and are numbered in increments of 20.

7.123 RESET Command

Syntax RESET

Purpose To close all files.

Remarks RESET closes all open files and forces all blocks in memory to be written to disk. Thus, if the machine loses power, all files will be properly updated.

All files must be closed before a disk is removed from its drive.

Example

```
998 RESET
999 END
```

7.124 RESTORE Statement

Syntax RESTORE [<line number>]

Purpose To allow DATA statements to be reread from a specified line.

Remarks After a RESTORE statement without a specified line number is executed, the next READ statement accesses the first item in the first DATA statement in the program.

If <line number> is specified, the next READ statement accesses the first item in the specified DATA statement.

Example

```
10 READ A,B,C
20 RESTORE
30 READ D,E,F
40 DATA 57, 68, 79
 .
 .
 .
```

7.125 RESUME Statement

Syntaxes

```
RESUME

RESUME 0

RESUME NEXT

RESUME <line number>
```

Purpose: To continue program execution after an error recovery procedure has been performed.

Remarks: Any one of the four syntaxes shown above may be used, depending upon where execution is to resume:

RESUME or RESUME 0	Execution resumes at the statement that caused the error.
RESUME NEXT	Execution resumes at the statement immediately following the one that caused the error.
RESUME <line number>	Execution resumes at <line number>.

A RESUME statement that is not in an error handling routine causes a "RESUME without error" message to be printed.

Example

```
10 ON ERROR GOTO 900
 .
 .
 .
900 IF (ERR=230)AND(ERL=90) THEN PRINT "TRY
AGAIN":RESUME 80
 .
 .
 .
```


7

7.126 RETURN Statement

See GOSUB...RETURN Statements, Section 7.54.

7.128 RMDIR Statement

Syntax RMDIR<pathname>

Purpose To remove an existing directory

Remarks PATHNAME is the name of the directory which is to be deleted. RMDIR works exactly like the MS-DOS command RMDIR. The PATHNAME must be a string of less than 128 characters.

The PATHNAME to be removed must be empty of any files except the working directory('.') and the parent directory('..') or else a "Path not found" or a "Path/File Access error" is given.

Example RMDIR "\SALES"

In this statement, the SALES directory on the current drive is to be removed.

7.129 RND Function

Syntax RND[(X)]

Purpose To return a random number between 0 and 1.

Remarks The same sequence of random numbers is generated each time the program is run unless the random number generator is reseeded (see "RANDOMIZE Statement," Section 7.119). However, X=0 always restarts the same sequence for any given X.

X > 0 or X omitted generates the next random number in the sequence. X = 0 repeats the last number generated.

Example

```
10 FOR I=1 TO 5
20   PRINT INT(RND*100);
30 NEXT I
```

might yield

```
24  30  31  51  5
```

Note The values produced by the RND function may vary with different implementations of Microsoft GW-BASIC.

7.132 SCREEN Statement

Syntax SCREEN [mode] [,[burst] [,[apage] [,vpage]]]

Purpose Sets screen attributes that control the subsequent display.

Remarks mode represents a numeric expression that results in an integer value of zero, 1, or 2. Valid vaules are:

zero = Test mode with current width (40 or 80)

1 = Medium resolution graphics mode (320 x 200)

2 = High resolution graphics mode (640 x 200)

burst is a numeric expression that results in a true or false value. In medium resolution graphics mode (mode = 1), a true value disables color, and a false falue enables it. This parameter cannot affect high resolution (mode = 2) and text mode (mode = zero).

apage (active page)
is an integer expression ranging from zero to 7 for width 40, or zero to 3 for width 80 that selects the page to be written to by output statements to the sreen, and is valid only in text mode.

vpage (visual page)
specifies which page is to be displayed on the screen, in the same way as apage, which may be different. Vpage is valid only in text mode, and if not specified, defaults to apage.

If all parameters are valid, the new screen mode is stored, the display is erased, the foreground color is set to white, and the background and border colors to black. Any subsequent screen output will be displayed according to the newly stored screen attributes. If the new mode is the same as the previous one, nothing changes.

In text mode, with only <page> and <vpage> specified, the effect is that of changing display pages for viewing. Initially, both pages default to zero. By manipulating the pages, you can display one page while building another, then switch visual pages instantaneously.

Note
One cursor is shared between all the pages. To switch active pages back and forth, first save the cursor position on the current active page with POS(0) and CSRLIN before changing to another active page. Then, on returning to the original page, the cursor position can be restored with the LOCATE statement.

Any omitted parameter, except vpage, assumes the old value.

In a program intended to run on a machine that may have either adapter, it is recommended that you use SCREEN 0,0,0 and WIDTH 40 statements at the beginning.

Examples

The first example specifies text mode with color, and sets both the active and visual pages to zero:

SCREEN 0,1,0,0

The next statement leaves mode and color burst unchanged, but sets the active page to 1 and the visual page to 2:

SCREEN ,,1,2

This statement changes to high resolution graphics mode:

SCREEN 2

7.135 SHELL Statement

Syntax SHELL [<command-string>]

Purpose To exit the BASIC program, run a COM or EXE or BAT program, or a built in DOS function such as DIR or TYPE, and return to the BASIC program at the line after the SHELL statement.

Remarks A COM, EXE, or BAT program or DOS function which runs under the SHELL statement is called a "Child process". Child processes are executed by SHELL loading and running a copy of COMMAND with the "/C" switch. By using COMMAND in this way, command line parameters are passed to the child. Standard input and output may be redirected, and built in commands such as DIR, PATH, and SORT may be executed.

The <command-string> must be a valid string expression containing the name of a program to run and (optionally) command arguments.

The program name in <command-string> may have any extension you wish. If no extension is supplied, COMMAND will look for a .COM file, then a .EXE file, and finally, a .BAT file. If COMMAND is not found, SHELL will issue a "File not found" error. No error is generated if COMMAND cannot find the the file specified in <command-string>.

Any text separated from the program name by at least one blank will be processed by COMMAND as program parameters.

BASIC remains in memory while the child process is running. When the child finishes, BASIC continues.

This version of GW-BASIC does not allow the user to SHELL to another copy of BASIC. If you attempt to do this, you will receive this error message: "You can not run BASIC as a child of BASIC" .

SHELL with no <command-string> will give you a new COMMAND shell. You may now do anything that COMMAND allows. When ready to return to BASIC, enter the DOS command: EXIT

Examples

```
SHELL 'get a new COMMAND

ADIR        {user types DIR to see files}

AEXIT       {user types EXIT to return to BASIC}

Ok           'now back in BASIC
```

Write some data to be sorted, SHELL sort to sort it, then read the sorted data to write a report.

```
900 OPEN "SORTIN.DAT" FOR OUTPUT AS  1
950 REM ** write data to be sorted
1000 CLOSE 1
1010 SHELL "SORT SORTIN.DAT SORTOUT.DAT"
1020 OPEN "SORTOUT.DAT" FOR INPUT AS  1
1030 REM ** Process the sorted data

10 SHELL "DIR   SORT FILES.
20 OPEN "FILES." FOR INPUT AS  1
```

Also see "BASIC and Child Processes", Section 5.7.

7

Note	Frequency	Note	Frequency
C	130.810	C*	523.250
D	146.830	D	587.330
E	164.810	E	659.260
F	174.610	F	698.460
G	196.000	G	783.990
A	220.000	A	880.000
B	246.940	B	987.770
C	261.630	C	1046.500
D	293.660	D	1174.700
E	329.630	E	1318.500
F	349.230	F	1396.900
G	392.000	G	1568.000
A	440.000	A	1760.000
B	493.880	B	1975.500

Higher (or lower) notes can be approximated by doubling (or halving) the frequency of the corresponding note in the previous (following) octave.

SOUND 32767, <duration> will create periods of silence.

The duration for each beat can be calculated by dividing the beats per minute into 1092 (the number of clock ticks in one minute).

The following table shows typical tempos in terms of clock ticks:

Tempo		Beats/Minute	Ticks/Beat
very slow	Larghissimo		
	Largo	40-60	27.3-18.2
	Larghetto	60-66	18.2-16.55
	Grave		
	Lento		
	Adagio	66-76	16.55-14.37
slow	Adagietto		
	Andante	76-108	14.37-10.11
medium	Andantino		
	Moderato	108-120	10.11-9.1
fast	Allegretto		
	Allegro	120-168	9.1-6.5
	Vivace		
	Veloce		
	Presto	168-208	6.5-5.25
very fast	Prestissimo		

Example

```
30 SOUND RND*1000+37,2
```

This statement creates random sounds.

7.139 SPC Function

Syntax SPC(n)

Purpose To skip spaces in a PRINT statement. n is the number is spaces to be skipped.

Remarks SPC may only be used with PRINT and LPRINT statements. n must be in the range 0 to 255. A';' is assumed to follow the SPC(n) command.

Example PRINT "OVER" SPC(15) "THERE"

will yield

OVER THERE

Also see SPACE$ Function, Section 7.138.

7.140 SQR Function

Syntax SQR(X)

Purpose To return the square root of X.

Remarks X must be > = 0.

Example

```
10 FOR X=10 TO 25 STEP 5
20    PRINT X, SQR(X)
30 NEXT X
```

will yield

```
10          3.162278
15          3.872984
20          4.472136
25          5
```

7.141 STICK Function

Syntax

x=STICK(n)

x is a numeric variable for storing the result of the function.

(n) is a numeric expression returning an unsigned integer in the range 0 to 3.

Purpose

To return the x and y coordinates of the two joysticks.

Remarks

The values returned for n can be:

0 - returns the x coordinate for joystick A. Also stores the x and y values for both joysticks for the following function calls:

1 - Returns the y coordinate of joystick A.

2 - Returns the x coordinate of joystick B.

3 - Returns the y coordinate of joystick B.

Example

```
10 CLS
20 LOCATE 1,1
30 PRINT "X=5";STICK(0)
40 PRINT "Y=5";STICK(1)
50 GOTO 20
```

This example creates an endless loop to display the value of the x,y coordinate for joystick A.

7.142 STOP Statement

Syntax STOP

Purpose To terminate program execution and return to command level.

Remarks STOP statements may be used anywhere in a program to terminate execution. STOP is often used for debugging. When a STOP is encountered, the following message is printed:

Break in line nnnnn

The STOP Statement doesn't close files.

Microsoft GW-BASIC always returns to command level after a STOP is executed. Execution is resumed by issuing a CONT command (see Section 7.22).

Example

```
10 INPUT A,B,C
20 K=A^2*5.3:L=B^3/.26
30 STOP
40 M=C*K+100:PRINT M
```

will yield

```
? 1,2,3
BREAK IN 30

PRINT L
 30.76923
CONT
 115.9
```

7.143 STR$ Function

Syntax STR$(n)

Purpose To return a string representation of the value of n.

Example

```
5 REM ARITHMETIC FOR KIDS
10 INPUT "TYPE A NUMBER";N
20 ON LEN(STR$(N)) GOSUB 30,100,200,300,400,500
 .
 .
 .
```

Also see VAL Function, Section 7.157.

7.144 STRIG Function

Syntax STRIG(n)

where x is a numeric variable for storing the result of the function.

(n) is a numeric expression returning an unsigned integer in the range 0 to 3, designating which trigger is to be checked.

Purpose To return the status of a specified joystick trigger.

Remarks In the STRIG(n) function, the values returned for (n) can be:

0 - Returns -1 if trigger A1 was pressed since the last STRIG(0) statement; returns 0 if not.

1 - Returns -1 if trigger A1 is currently down, 0 if not.

2 - Returns -1 if trigger B1 was pressed since the last STRIG(2) statement, 0 if not.

3 - Returns -1 if trigger B1 is currently down, 0 if not.

4 - will return -1 if button A2 was pressed since the last STRIG(4), and zero if not.

5 - will return-1 if button A2 is currently pressed, and zero if not.

6 - will return-1 if button B2 was pressed since the last STRIG(6), and zero if not.

7 - will return-1 if button B2 is currently pressed, and zero if not.

When a joystick event trap occurs, that occurrence of the event is destroyed. Therefore, the x=STRIG(n) function will always return false inside a subroutine, unless the event has been repeated since the trap. So if you wish to perform different procedures for various joysticks, you must set up a different subroutine for each joystick, rather than including all the procedures in a single subroutine.

Example

```
10 IF STRIG(0) THEN BEEP
20 GOTO 10
```

Example

```
10 IF STRIG(0) THEN BEEP
20 GOTO 10
```

In this example an endless loop is created to beep whenever the trigger button on joystick 0 is pressed.

7.145 STRIG(n) ON, STRIG(n) OFF, STRIG(n) STOP Statements

Syntax

```
STRIG(n) ON
STRIG(n) OFF
STRIG(n) STOP
```

Purpose

The STRIG(n) ON statement enables event trapping of joystick activity.

The STRIG(n) OFF statement disables event trapping of joystick activity.

The STRIG(n) STOP statement disables event trapping of joystick activity.

Remarks

n can be 0,2,4 or 6, and specifies the button to be trapped as follows:

0=button A1
2=button B1
4=button A2
6=button B2

The STRIG(n) ON statement enables joystick event trapping by an ON STRIG(n) statement (see STRIG(n) Statement, Section 7.145). While trapping is enabled, and if a non-zero line number is specified in the ON STRIG(n) statement, GW-BASIC checks between every statement to see if the joystick trigger has been pressed.

The STRIG(n) OFF statement disables event trapping. If a subsequent event occurs (i.e., if the trigger is pressed), it will not be remembered when the next STRIG ON is invoked.

The STRIG(n) STOP statement disables event trapping, but if an event occurs it will be remembered, and the event trap will take place as soon as trapping is reenabled.

7.146 STRING$ Function

Syntaxes

```
STRING$(I,J)
STRING$(I,X$)
```

Purpose

To return a string of length I whose characters all have ASCII code J or the first character of X$.

Examples

```
10 DASH$ = STRING$(10,45)
20 PRINT DASH$;"MONTHLY REPORT";DASH$
```

will yield

```
----------MONTHLY REPORT----------
```

```
10 LET A$ = "HOUSTON"
20 LET X$ = STRING$(8,A$)
30 PRINT X$
```

will yield

```
HHHHHHHH
```

7.147 SWAP Statement

Syntax: SWAP <variable>,<variable>

Purpose: To exchange the values of two variables.

Remarks: Any type variable may be swapped (integer, single precision, double precision, string), but the two variables must be of the same type or a "Type mismatch" error results.

If the second variable is not already defined when SWAP is executed, an "Illegal function call" error will result.

Example:

```
10 A$=" ONE " : B$=" ALL " : C$="FOR"
20 PRINT A$ C$ B$
30 SWAP A$, B$
40 PRINT A$ C$ B$
```

will yield

```
 ONE FOR ALL
 ALL FOR ONE
```

7.148 SYSTEM Command

Syntax SYSTEM

Purpose To close all open files and return control to the operating system.

Remarks When a SYSTEM command is executed, all files are closed, and BASIC performs an exit to the operating system.

7.149 TAB Function

Syntax TAB(I)

Purpose To move the print position to I.

Remarks If the current print position is already beyond space I, TAB goes to that position on the next line. Space 1 is the leftmost position, and the rightmost position is the width minus one. I must be in the range 1 to 255. TAB may only be used in PRINT and LPRINT statements.

Example

```
10 PRINT "NAME" TAB(25) "AMOUNT" : PRINT
20 READ A$,B$
30 PRINT A$ TAB(25) B$
40 DATA "G. T. JONES","$25.00"
```

will yield

```
NAME                    AMOUNT

G. T. JONES             $25.00
```

7.150 TAN Function

Syntax TAN(X)

Purpose To return the tangent of X. X should be given in radians.

Remarks With the interpreter, if TAN overflows, the "Overflow" error message is displayed, machine infinity with the appropriate sign is supplied as the result, and execution continues.

Example

```
10 Y=Q*TAN(X)/2
```

7.151 TIME$ Statement

Syntax TIME$=<string expression>

<string expression> returns a string in one of the following forms:

hh (sets the hour; minutes and seconds default to 00)

hh:mm (sets the hour and minutes; seconds default to 00)

hh:mm:ss (sets the hour, minutes, and seconds)

Purpose To set the time. This statement complements the TIME$ function, which retrieves the time.

Remarks A 24-hour clock is used; 8:00 p.m., therefore, would be entered as 20:00:00.

Example

```
10 TIME$="08:00:00"
```

The current time is set at 8:00 a.m.

7.152 TIME$ Function

Syntax TIME$

Purpose To retrieve the current time. (To set the time, use the TIME$ statement, described in Section 7.151.)

Remarks The TIME$ function returns an eight-character string in the form hh:mm:ss, where hh is the hour (00 through 23), mm is minutes (00 through 59), and ss is seconds (00 through 59). A 24-hour clock is used; 8:00 p.m., therefore, would be shown as 20:00:00.

Example 10 PRINT TIME$

Prints the time, calculated from the time set with the TIME$ statement.

7.153 TIMER Function

Syntax v = TIMER

Purpose Tracks the number of elapsed seconds since midnight or system reset. For use in BASIC 2.0 and later only.

Remarks TIMER returns a single-precision number. Fractional second are expressed in the nearest possible degree. This is a read only function.

Example

```
100 TIME$="23:59:59"
200 FOR I=1 to 15
300 PRINT "TIME$= ",TIME$,"TIMER= ";TIMER
400 NEXT
RUN
TIME$= 23:59:59      TIMER= 86399.11
TIME$= 23:59:59      TIMER= 86399.22
TIME$= 23:59:59      TIMER= 86399.39
TIME$= 23:59:59      TIMER= 86399.5
TIME$= 23:59:59      TIMER= 86399.61
TIME$= 23:59:59      TIMER= 86399.72
TIME$= 23:59:59      TIMER= 86399.83
TIME$= 23:59:59      TIMER= 86399.94
TIME$= 23:59:59      TIMER= 86400.05
TIME$= 00:00:00      TIMER= .05
TIME$= 00:00:00      TIMER= .21
TIME$= 00:00:00      TIMER= .32
TIME$= 00:00:00      TIMER= .43
TIME$= 00:00:00      TIMER= .49
TIME$= 00:00:00      TIMER= .6
Ok
```

7.154 TIMER ON, TIMER OFF, TIMER STOP Statements

Syntax

```
TIMER ON
TIMER OFF
TIMER STOP
```

Purpose

TIMER ON enables event trapping during real time.
TIMER OFF disables event trapping during real time.
TIMER STOP suspends real time event trapping.

Remarks

The TIMER ON statement enables real time event trapping by an ON TIMER statement (see "ON TIMER Statement," Section 7.98). While trapping is enabled with the ON TIMER statement, GW-BASIC checks between every statement to see if the timer has reached the specified level. If it has, the ON TIMER statement is executed.

TIMER OFF disables the event trap. If an event takes place, it is not remembered if a subsequent TIMER ON is used.

TIMER STOP disables the event trap, but if an event occurs, it is remembered and an ON TIMER statement will be executed as soon as trapping is enabled.

Also see ON TIMER Statement, Section 7.98.

7.155 TRON/TROFF Statements/Commands

Syntax

TRON

TROFF

Purpose

To trace the execution of program statements.

Remarks

As an aid in debugging, the TRON statement may be executed in either direct or indirect mode. With TRON in operation, each line number of the program is printed on the screen as it is executed.

The numbers appear enclosed in square brackets. The trace flag is disabled with the TROFF statement (or when a NEW command is executed).

Example

```
TRON

10 K=10
20 FOR J=1 TO 2
30    L=K + 10
40    PRINT J;K;L
50    K=K + 10
60 NEXT J
70 END
```

will yield

```
[10][20][30][40] 1  10  20
[50][60][30][40] 2  20  30
[50][60][70]
```

7.156 USR Function

Syntax

USR[<digit>][(<argument>)]

where <digit> specifies which USR routine is being called. See the DEF USR statement, Section 7.33, for rules governing <digit>. If <digit> is omitted, USR0 is assumed.

<argument> is the value passed to the subroutine. It may be any numeric or string expression.

Purpose

To call an assembly language subroutine.

Remarks

If a segment other than the default segment (data segment) is to be used, a DEF SEG statement must be executed prior to a USR function call. The address given in the DEF SEG statement determines the segment address of the subroutine.

For each USR function, a corresponding DEF USR statement must be executed to define the USR call offset. This offset and the currently active DEF SEG segment address determine the starting address of the subroutine.

Example

```
100 DEF SEG=&H8000
110 DEF USR0=0
120 X=5
130 Y = USR0(X)
140 PRINT Y
```

The type (numeric or string) of the variable receiving the value must be consistent with the argument passed. This setup of the string space differs from that of the interpreter.

7

7.157 VAL Function

Syntax

VAL(<string>)

<string> must be a numeric character stored as a string.

Purpose

To return the numeric value of string <string>. The VAL function also strips leading blanks, tabs, and linefeeds from the argument string. For example,

VAL(" -3")

returns -3.

Example

```
10 READ NAME$,CITY$,STATE$,ZIP$
20 IF VAL(ZIP$)<90000 OR VAL(ZIP$)>96699
     THEN PRINT NAME$ TAB(25) "OUT OF STATE"
30 IF VAL(ZIP$)>=90801 AND VAL(ZIP$)<=90815
     THEN PRINT NAME$ TAB(25) "LONG BEACH"
 .
 .
 .
```

See the STR$ function, Section 7.143, for details on numeric-to-string conversion.

7.158 VARPTR Function

Syntax 1 VARPTR(<variable name>)

Syntax 2 VARPTR(#<file number>)

Purpose Syntax 1

Returns the address of the first byte of data identified with <variable name>. The variable must have been defined prior to the execution of the VARPTR function. Otherwise an "Illegal function call" error results. Variables are defined by executing any reference to the variable.

Any type variable name may be used (numeric, string, array). For string variables, the address of the first byte of the string descriptor is returned (see "Assembly Language Subroutines," Section 6.1 for discussion of the string descriptor). The address returned will be an integer in the range 32767 to -32768. If a negative address is returned, add it to 65536 to obtain the actual address.

VARPTR is usually used to obtain the address of a variable or array so that it may be passed to an assembly language subroutine. A function call of the form VARPTR(A(0)) is usually specified when passing an array, so that the lowest-addressed element of the array is returned.

Note All simple variables should be assigned before calling VARPTR for an array, because the addresses of the arrays change whenever a new simple variable is assigned.

Syntax 2

For sequential files, returns the starting address of the disk I/O buffer assigned to <file number>. For random files, returns the address of the FIELD buffer assigned to <file number>.

Example

```
100 X=USR(VARPTR(Y))
```

7.159 VARPTR$ Function

Syntax

VARPTR$(<variable name>)

where <variable name> is the name of a variable in the program.

Purpose

To return a character form of the memory address of the variable in a form that is compatible for programs that may later be compiled.

Remarks

VARPTR$ is primarily used to execute substrings with the DRAW and PLAY statements (Sections 7.36 and 7.105, respectively) in programs that will later be compiled. With programs that will not be later compiled, the standard syntax of the PLAY and DRAW statements will be sufficient to produce desired effects.

The variable must have been defined prior to the execution of the VARPTR function. Otherwise an "Illegal function call" error results. Variables are defined by executing any reference to the variable.

VARPTR$ returns a three-byte string in the form:

```
byte 0 = type, where type is: 2 integer
                              3 string
                              4 single-precision
                              8 double-precision
byte 1 = low byte of address
byte 2 = high byte of address
```

Note, however, that the individual parts of the string are not considered characters.

Note

Because array addresses, string addresses and file data block change whenever a new variable is assigned, it is unsafe to save the result of a VARPTR function in a variable. It is recommended that VARPTR is executed before each use of the result.

Example

10 PLAY "X"+VARPTR$(A$)

Uses the subcommand X (execute), plus the contents of A$, as the string expression in the PLAY statement.

7.160 VIEW Statement

Syntax VIEW [[SCREEN] [(Vx1,Vy1)-(Vx2,Vy2) [,[<color>] [,[<border>]]]]]

Purpose To define screen limits for graphics activity.

Remarks VIEW defines a "Physical Viewport" limit from Vx1,Vy1 (upper left x,y coordinates) to Vx2,Vy2 (lower right x,y coordinates). The x and y coordinates must be within the physical bounds of the screen. The physical viewport defines the rectangle within the screen into which graphics may be mapped.

RUN, and SCREEN and VIEW with no arguments, define the entire screen as the viewport.

The <color> attribute allows the user to fill the view area with a color. If color is omitted, the view area is not filled.

The <border> attribute allows the user to draw a line surrounding the viewport if space for a border is available. If border is omitted, no border is drawn.

The [SCREEN] option dictates that the x and y coordinates are absolute to the screen, not relative to the border of the physical viewport, and only graphics within the viewport will be plotted.

Examples For the form: VIEW (Vx1,Vy1)-(Vx2,Vy2)

all points plotted are relative to the viewport. That is, Vx1 and Vy1 are added to the x and y coordinates before putting the point down on the screen.

If: VIEW (10,10)-(200,100)

were executed, then the point set down by the statement PSET (0,0),3 would actually be at the physical screen location 10,10.

For the form: VIEW SCREEN (Vx1,Vy1)-(Vx2,Vy2)

all coordinates are screen absolute rather than viewport relative.

If: VIEW SCREEN (10,10)-(200,100)

were executed, then the point set down by the statement PSET (0,0),3 would actually not appear because 0,0 is outside of the Viewport. PSET (10,10),3 is within the Viewport, and places the point in the upper-left hand corner of the viewport.

A number of VIEW statements may be executed. If the newly described viewport is not wholly within the previous viewport, the screen can be re-initialized with the VIEW statement. Then the new viewport may be stated. If the new viewport is entirely within the previous one, as in the following example, the intermediate VIEW statement. isn't necessary. This example opens three viewports, each smaller than the previous one. In each case, a line that is defined to go beyond the borders is programmed, but appears only within the viewport border.

```
260 CLS
280 VIEW: REM ** Make the viewport the entire
screen.
300 VIEW (10,10) - (300,180),,1
320    CLS
340    LINE (0,0) - (310,190),1
360    LOCATE 1,11: PRINT "A big viewport"
380 VIEW SCREEN (50,50)-(250,150),,1
400    CLS:REM** Note, CLS clears only viewport
420    LINE (300,0)-(0,199),1
440    LOCATE 9,9: PRINT "A medium viewport"
460 VIEW SCREEN (80,80)-(200,125),,1
480    CLS
500    CIRCLE (150,100),20,1
520    LOCATE 11,9: PRINT "A small viewport"
```

7.161 VIEW PRINT Statement

Syntax: VIEW PRINT [<top screen line> TO <bottom screen line>]

Purpose: To set the boundaries of the screen text window.

Remarks: VIEW PRINT without top and bottom line parameters initializes the whole screen area as the text window.

Statements and functions which operate within the defined text window include CLS, LOCATE PRINT and SCREEN.

The Screen Editor will limit functions such as scroll and cursor movement to the text window.

Also see the VIEW Statement, Section 7.160.

7.162 WAIT Statement

Syntax WAIT <port number>,I[,J]

where I and J are integer expressions.

Purpose To suspend program execution while monitoring the status of a machine input port.

Remarks The WAIT statement causes execution to be suspended until a specified machine input port develops a specified bit pattern. The data read at the port is exclusive OR'ed with the integer expression J, and then AND'ed with I. If the result is zero, Microsoft GW-BASIC loops back and reads the data at the port again. If the result is nonzero, execution continues with the next statement. If J is omitted, it is assumed to be zero

Warning It is possible to enter an infinite loop with the WAIT statement, in which case it will be necessary to manually restart the machine. To avoid this, WAIT must have the specified value at <port number> during some point in the program execution.

Example 100 WAIT 32,2

7.163 WHILE...WEND Statements

Syntax

WHILE <expression>
.
.
[<loop statements>]
.
.
WEND

Purpose

To execute a series of statements in a loop as long as a given condition is true.

Remarks

If <expression> is not zero (i.e., true), <loop statements> are executed until the WEND statement is encountered. Microsoft GW-BASIC then returns to the WHILE statement and checks <expression>. If it is still true, the process is repeated. If it is not true, execution resumes with the statement following the WEND statement.

WHILE/WEND loops may be nested to any level. Each WEND will match the most recent WHILE. An unmatched WHILE statement causes a "WHILE without WEND" error, and an unmatched WEND statement causes a "WEND without WHILE" error.

Example

```
90 'BUBBLE SORT ARRAY A$ WHICH HAS J ELEMENTS.
100 FLIPS=1 'FORCE ONE PASS THRU LOOP
110 WHILE FLIPS
115    FLIPS=0
120    FOR I=1 TO J-1
130       IF A$(I)>A$(I+1) THEN
             SWAP A$(I),A$(I+1):FLIPS=1
140    NEXT I
150 WEND
```

Note

Do not direct program flow into a WHILE/WEND loop without entering through the WHILE statement.

7.164 WIDTH Statement

Syntax 1 WIDTH LPRINT <size>

Syntax 2 WIDTH<file number>,<size>

Syntax 3 WIDTH<device>,<size>

<size> is a numeric expression in the range 0 to 255. It specifies the width of the printed line. The default width is 72 characters. If <integer expression> is 255, the line width is "infinite"; that is, Microsoft GW-BASIC never inserts a carriage return. However, the position of the cursor or the print head, as given by the POS or LPOS function, returns to zero after position 255.

<file number> is a numeric expression in the range 1 to 15. This is the number of the file that is open.

<device> is a string expression indicating the device that is to be used.

Purpose To set the printed line width in number of characters for the screen or line printer.

Remarks Syntax 1:If the LPRINT option is omitted, the line width is set at the screen. If LPRINT is included, the line width is set at the line printer.

The WIDTH statement may cause the screen to be cleared.

Syntax 2: With Syntax 2, if the file is open, the width is immediately changed to the specified size. This allows the width to be changed while the file is open.

Syntax 3: With Syntax 3, the default line width for the specified device is set to <size>. The line widths of currently open files are not modified. A subsequent OPEN <filespec> FOR OUTPUT AS #n will use the specified value for the width initially.

Example

```
10 WIDTH "LPT1:", 5
20 OPEN "LPT1:" FOR OUTPUT AS 1
30 PRINT  1, "1234567890"
35 PRINT  1
40 WIDTH  1, 6
50 PRINT  1, "1234567890"
RUN
```

will yield on the printer

```
12345
67890

123456
7890
```

7.165 WINDOW Statement

Syntax

WINDOW [[SCREEN] (Wx1,Wy1)-(Wx2,Wy2)]

where:

(Wx1,Wy1)-(Wx2,Wy2) are the world coordinates specified by the programmer to define the coordinates of the lower left and upper right screen border.

SCREEN inverts the y axis of the world coordinates so that screen coordinates coincide with the traditional Cartesian arrangement: x increases left to right, and y decreases top to bottom.

Purpose

To define the logical dimensions of the current viewport.

Remarks

WINDOW allows the user to to redefine the screen border coordinates.

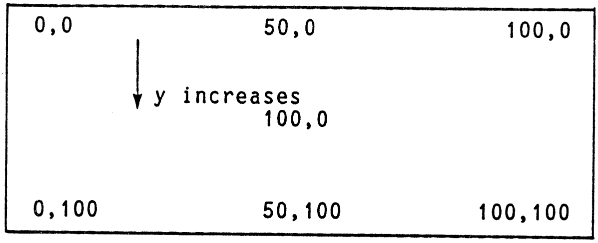
WINDOW allows the user to draw lines, graphs, or objects in space not bounded by the physical dimensions of the screen. This is done by using programmer-defined coordinates called "World coordinates". When the programmer has redefined the screen, graphics can be drawn within a customized mapping system.

BASIC converts world coordinates into physical coordinates for subsequent display within the current viewport. To make this transformation from world space to the physical space of the viewing surface (screen), one must know what portion of the (floating point) world coordinate space contains the information to be displayed. This rectangular region in world coordinate space is called a Window.

RUN, or WINDOW with no arguments, disables "Window" transformation.

The WINDOW SCREEN variant inverts the normal Cartesian direction of the y coordinate. Consider the following:

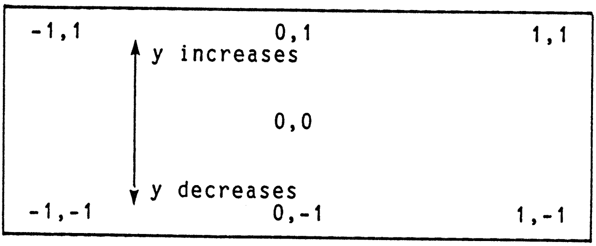
In the default, a section of the screen appears as:



now execute:

WINDOW (-1,-1)-(1,1)

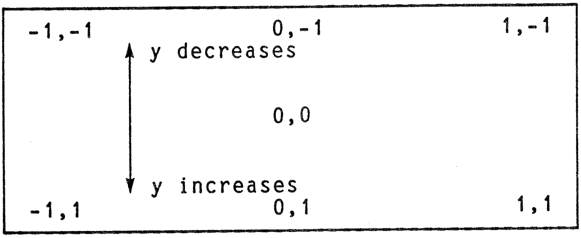
and the screen appears as:



If the variant:

```
WINDOW SCREEN (-1,-1)-(1,1)
```

is executed then the screen appears as:



The following example illustrates two lines with the same endpoint coordinates. The first is drawn on the default screen, and the second is on a redefined window.

```
200 LINE (100,100) - (150,150), 1
220 LOCATE 2,20:PRINT "The line on the
 default screen"
240 WINDOW SCREEN (100,100) - (200,200)
260 LINE (100,100) - (150,150), 1
280 LOCATE 8,18:PRINT"& the same line on a
 redefined window"
```

7.166 WRITE Statement

Syntax WRITE [<list of expressions>]

Purpose To output data to the screen.

Remarks If <list of expressions> is omitted, a blank line is output. If <list of expressions> is included, the values of the expressions are output to the screen. The expressions in the list may be numeric and/or string expressions. They must be separated by commas.

When the printed items are output, each item is separated from the last by a comma. Printed strings are delimited by quotation marks. After the last item in the list is printed, GW-BASIC inserts a carriage return/linefeed.

WRITE outputs numeric values using the same format as the PRINT statement. (See Section 7.113.)

Example

```
10 A=80:B=90:C$="THAT'S ALL"
20 WRITE A,B,C$
```

will yield

```
80, 90,"THAT'S ALL"
```

7.167 WRITE# Statement

Syntax WRITE#<file number>,<list of expressions>

Purpose To write data to a sequential file.

Remarks <file number> is the number under which the file was OPENed in "O" mode (see "OPEN Statement," Section 7.99). The expressions in the list are string or numeric expressions. They must be separated by commas.

The difference between WRITE# and PRINT# is that WRITE# inserts commas between the items as they are written to the file and delimits strings with quotation marks. Therefore, it is not necessary for the user to put explicit delimiters in the list. A carriage return/linefeed sequence is inserted after the last item in the list is written to the file.

Example Let A$="CAMERA" and B$="93604-1"

The statement:

```
WRITE#1,A$,B$
```

writes the following image to disk:

```
"CAMERA","93604-1"
```

A subsequent INPUT# statement, such as

```
INPUT#1,A$,B$
```

would input "CAMERA" to A$ and "93604-1" to B$.

APPENDICES

8

APPENDIX A

ASCII CHARACTER CODES

Dec	Hex	CHR	Dec	Hex	CHR
000	00H	NUL	033	21H	!
001	01H	SOH	034	22H	"
002	02H	STX	035	23H	#
003	03H	ETX	036	24H	$
004	04H	EOT	037	25H	%
005	05H	ENQ	038	26H	&
006	06H	ACK	039	27H	'
007	07H	BEL	040	28H	(
008	08H	BS	041	29H	)
009	09H	HT	042	2AH	*
010	0AH	LF	043	2BH	+
011	0BH	VT	044	2CH	,
012	0CH	FF	045	2DH	-
013	0DH	CR	046	2EH	.
014	0EH	SO	047	2FH	/
015	0FH	SI	048	30H	0
016	10H	DLE	049	31H	1
017	11H	DC1	050	32H	2
018	12H	DC2	051	33H	3
019	13H	DC3	052	34H	4
020	14H	DC4	053	35H	5
021	15H	NAK	054	36H	6
022	16H	SYN	055	37H	7
023	17H	ETB	056	38H	8
024	18H	CAN	057	39H	9
025	19H	EM	058	3AH	:
026	1AH	SUB	059	3BH	;
027	1BH	ESCAPE	060	3CH	
028	1CH	FS	061	3DH	=
029	1DH	GS	062	3EH	
030	1EH	RS	063	3FH	?
031	1FH	US	064	40H	§
032	20H	SPACE			

Dec=decimal, Hex=hexadecimal (H), CHR=character.
LF=Line Feed, FF=Form Feed, CR=Carriage Return, DEL=Rubout

NIXDORF
COMPUTER

ASCII CHARACTER CODES

Dec	Hex	CHR	Dec	Hex	CHR
065	41H	A	097	61H	a
066	42H	B	098	62H	b
067	43H	C	099	63H	c
068	44H	D	100	64H	d
069	45H	E	101	65H	e
070	46H	F	102	66H	f
071	47H	G	103	67H	g
072	48H	H	104	68H	h
073	49H	I	105	69H	i
074	4AH	J	106	6AH	j
075	4BH	K	107	6BH	k
076	4CH	L	108	6CH	l
077	4DH	M	109	6DH	m
078	4EH	N	110	6EH	n
079	4FH	O	111	6FH	o
080	50H	P	112	70H	p
081	51H	Q	113	71H	q
082	52H	R	114	72H	r
083	53H	S	115	73H	s
084	54H	T	116	74H	t
085	55H	U	117	75H	u
086	56H	V	118	76H	v
087	57H	W	119	77H	w
088	58H	X	120	78H	x
089	59H	Y	121	79H	y
090	5AH	Z	122	7AH	z
091	5BH		123	7BH	
092	5CH		124	7CH	
093	5DH		125	7DH	
094	5EH		126	7EH	
095	5FH		128	7FH	DEL
096	60H	⊤			

Dec=decimal, Hex=hexadecimal (H), CHR=character.
LF=Line Feed, FF=Form Feed, CR=Carriage Return, DEL=Rubout

8

APPENDIX B

ERROR CODES AND ERROR MESSAGES

Number

1 NEXT without FOR

A variable in a NEXT statement does not correspond to any previously executed, unmatched FOR statement variable.

2 Syntax error

A line is encountered that contains some incorrect sequence of characters (such as an unmatched parenthesis, misspelled command or statement, incorrect punctuation, etc.).

With GW-BASIC, the incorrect line will be part of a DATA statement.

Microsoft GW-BASIC Interpreter automatically enters edit mode at the line that caused the error.

3 Return without GOSUB

A RETURN statement is encountered for which there is no previous, unmatched GOSUB statement.

4 Out of data

A READ statement is executed when there are no DATA statements with unread data remaining in the program.

5 Illegal function call

A parameter that is out of range is passed to a math or string function. An FC error may also occur as the result of:

ERROR CODES AND ERROR MESSAGES

1. A negative or unreasonably large subscript.
2. A negative or zero argument with LOG.
3. A negative argument to SQR.
4. A negative mantissa with a noninteger exponent.
5. A call to a USR function for which the starting address has not yet been given.
6. An improper argument to MID$, LEFT$, RIGHT$, INP, OUT, WAIT, PEEK, POKE, TAB, SPC, STRING$, SPACE$, INSTR, or ON...GOTO.
7. A negative record number used with GET or PUT.

6 Overflow

The result of a calculation is too large to be represented in Microsoft GW-BASIC number format. If underflow occurs, the result is zero and execution continues without an error.

7 Out of memory

A program is too large, or has too many FOR loops or GOSUBs, too many variables, or expressions that are too complicated for a file buffer to be allocated.

8 Undefined line

A nonexistent line is referenced in a GOTO, GOSUB, IF...THEN...ELSE, or DELETE statement.

9 Subscript out of range

An array element is referenced either with a subscript that is outside the dimensions of the array or with the wrong number of subscripts.

8

10 Duplicate definition

Two DIM statements are given for the same array; or, a DIM statement is given for an array after the default dimension of 10 has been established for that array.

11 Division by zero

A division by zero is encountered in an expression; or, the operation of involution results in zero being raised to a negative power. Machine infinity with the sign of the numerator is supplied as the result of the division, or positive machine infinity is supplied as the result of the involution, and execution continues.

12 Illegal direct

A statement that is illegal in direct mode is entered as a direct mode command.

13 Type mismatch

A string variable name is assigned a numeric value or vice versa; a function that expects a numeric argument is given a string argument or vice versa.

14 Out of string space

String variables have caused BASIC to exceed the amount of free memory remaining. Microsoft GW-BASIC will allocate string space dynamically, until it runs out of memory.

15 String too long

An attempt is made to create a string more than 255 characters long.

16 String formula too complex

A string expression is too long or too complex. The expression should be broken into smaller expressions.

17 Can't continue

An attempt is made to continue a program that:

1. Has halted due to an error.
2. Has been modified during a break in execution.
3. Does not exist.

18 Undefined user function

A USR function is called before the function definition (DEF statement) is given.

19 No RESUME

An error handling routine is entered but contains no RESUME statement.

20 RESUME without error

A RESUME statement is encountered before an error handling routine is entered.

21 Unprintable error

An error message is not available for the error condition that exists.

22 Missing operand

An expression contains an operator with no operand following it.

23 Line buffer overflow

An attempt has been made to input a line that has too many characters.

24 Device timeout

The device you have specified is not available at this time.

25 Device fault

An incorrect device designation has been entered.

26 FOR without NEXT

A FOR statement was encountered without a matching NEXT.

27 Out of paper

The printer device is out of paper.

28 Unprintable error

An error message is not available for the condition which exists.

29 WHILE without WEND

A WHILE statement does not have a matching WEND.

30 WEND without WHILE

A WEND statement was encountered without a matching WHILE.

31-49 Unprintable error

An error message is not available for the condition which exists.

ERROR CODES AND ERROR MESSAGES

Disk Errors

50 Field overflow

A FIELD statement is attempting to allocate more bytes than were specified for the record length of a random file.

51 Internal error

An internal malfunction has occurred in Microsoft GW-BASIC. Report to Microsoft the conditions under which the message appeared.

52 Bad file number

A statement or command references a file with a file number that is not OPEN or is out of the range of file numbers specified at initialization.

53 File not found

A LOAD, KILL, NAME, or OPEN statement/command references a file that does not exist on the current disk.

54 Bad file mode

An attempt is made to use PUT, GET, or LOF with a sequential file, to LOAD a random file, or to execute an OPEN statement with a file mode other than I, O, or R.

55 File already open

A sequential output mode OPEN statement is issued for a file that is already open; or a KILL statement is given for a file that is open.

56 Unprintable error

An error message is not available for the condition that exists.

57 Device I/O error

An I/O error occurred on a disk I/O operation. It is a fatal error; i.e., the operating system cannot recover from the error.

58 File already exists

The filename specified in a NAME statement is identical to a filename already in use on the disk.

59-60 Unprintable error

An error message is not available for the condition that exists.

61 Disk full

All disk storage space is in use.

62 Input past end

An INPUT statement is executed after all the data in the file has been INPUT, or for a null (empty) file. To avoid this error, use the EOF function to detect the end-of-file.

63 Bad record number

In a PUT or GET statement, the record number is either greater than the maximum allowed (32,767) or equal to zero.

64 Bad file name

An illegal form is used for the filename with a LOAD, SAVE, KILL, or OPEN statement (e.g., a filename with too many characters).

65 Unprintable error

An error message is not available for the condition that exists.

66 Direct statement in file

A direct statement is encountered while LOADing an ASCII-format file. The LOAD is terminated.

67 Too many files

An attempt is made to create a new file (using SAVE or OPEN) when all 255 directory entries are full.

68 Device Unavailable

The device that has been specified is not available at this time.

69 Communications buffer overflow

Not enough space has been reserved for communications I/O.

70 Disk write protected

The disk has a write protect tab intact, or is a disk that cannot be written to.

71 Disk not ready

Could be caused by a number of problems. The most likely is that the disk is not inserted properly.

72 Disk media error

A hardware or disk problem occurred while the disk was being written to or read from. For example, the disk may be damaged or the disk drive may not be working properly.

74 Rename across disks

An attempt was made to rename a file with a new drive designation. This is not allowed.

75 Path/file access error

During an OPEN, MKDIR, CHDIR, or RMDIR operation, MS-DOS was unable to make a correct Path to File name connection. The operation is not completed.

76 Path not Found

During an OPEN, MKDIR, CHDIR, or RMDIR operation, MS-DOS was unable to find the path specified. The operation is not completed.

** You cannot run BASIC as a Child of BASIC

No error number. During initialization, BASIC discovers that it is being run as a Child. BASIC is not run and control returns to the Parent copy of BASIC.

** Can't continue after SHELL

No error number. Upon returning from a Child process, the SHELL statement discovers that there is not enough memory for BASIC to continue. BASIC closes any open files and exits to MS-DOS.

APPENDIX C

MICROSOFT GW-BASIC RESERVED WORDS

The following is a list of reserved words used in Microsoft GW-BASIC.

ABS
AND
ASC

ATN
AUTO
BEEP
BLOAD
BSAVE
CALL
CDBL
CHAIN
CHDIR
CHR$

CINT
CIRCLE
CLEAR
CLOSE
CLS
COLOR
COM
COMMON
CONT
COS
CSNG
CVD

CVI
CVS
DATA
DATE$
DEFDBL
DEFINT
DEFSNG

DEFSNG
DEFSTR
DEF FN

DEF USR
DELETE
DIM
DRAW
EDIT
ELSE
END
ENVIRON
EOF
ERASE
ERDEV
ERL
ERR
ERROR
END
EXP
FIELD
FILES
FIX
FOR
FRE
GET
GOSUB

HEX$
IF
IMP
INP
INPUT
INKEY$
INPUT#

INPUT$
INSTR
INT
IOCTL
KEY
KILL
LEFT$
LEN
LET
LINE
LIST
LLIST

LOAD

LOC
LOCATE
LOF
LOG
LPOS
LPRINT
LSET
MERGE
MID$
MKD$
MKI$
MKS$
MKDIR
MOD
MOTOR
NAME
NEW
NEXT
NOT
OCT$

MICROSOFT GW-BASIC RESERVED WORDS

ON
OPEN
OPEN COM
OPTION
OR
PAINT
PALETTE
PALETTE USING
PEEK
PEN
PLAY
PMAP
POINT
POKE
POS
PRESET
PRINT
PRINT# USING
PSET
PUT
RANDOMIZE
READ
REM
RENUM
RESET

RESTORE
RESUME
RIGHT$
RMDIR
RND
RSET
RUN
SAVE
SGN

SHELL
SIN
SOUND
SPACE
SPC
SQR
STICK
STOP
STR$
STRIG
STRING$
SWAP

SYSTEM
TAB
TAN
THEN
TIME$
TO
TROFF
TRON
USING
USR
VAL
VARPTR
VARPTR$
VIEW
WAIT
WEND
WHILE
WIDTH
WINDOW
WRITE
WRITE#
XOR

APPENDIX D

MATHEMATICAL FUNCTIONS NOT INTRINSIC TO GW-BASIC

Derived Functions

Functions that are not intrinsic to Microsoft GW-BASIC may be calculated as follows.

Function	Microsoft GW-BASIC Equivalent
SECANT	SEC(X)=1/COS(X)
COSECANT	CSC(X)=1/SIN(X)
COTANGENT	COT(X)=1/TAN(X)
INVERSE SINE	ARCSIN(X)=ATN(X/SQR(-X*X+1))
INVERSE COSINE	ARCCOS(X)=-ATN(X/SQR(-X*X+1))+1.5708
INVERSE SECANT	ARCSEC(X)=ATN(X/SQR(X*X-1)) +SGN(SGN(X)-1)*1.5708
INVERSE COSECANT	ARCCSC(X)=ATN(X/SQR(X*X-1)) +(SGN(X)-1)*1.5708
INVERSE COTANGENT	ARCCOT(X)=ATN(X)+1.5708
HYPERBOLIC SINE	SINH(X)=(EXP(X)-EXP(-X))/2
HYPERBOLIC COSINE	COSH(X)=(EXP(X)+EXP(-X))/2
HYPERBOLIC TANGENT	TANH(X)=(EXP(X)-EXP(-X))/ (EXP(X)+EXP(-X))
HYPERBOLIC SECANT	SECH(X)=2/(EXP(X)+EXP(-X))
HYPERBOLIC COSECANT	CSCH(X)=2/(EXP(X)-EXP(-X))
HYPERBOLIC COTANGENT	COTH(X)=(EXP(X)+EXP(-X))/ (EXP(X)-EXP(-X))
INVERSE HYPERBOLIC SINE	ARCSINH(X)=LOG(X+SQR(X*X+1))
INVERSE HYPERBOLIC COSINE	ARCCOSH(X)=LOG(X+SQR(X*X-1))
INVERSE HYPERBOLIC TANGENT	ARCTANH(X)=LOG((1+X)/(1-X))/2
INVERSE HYPERBOLIC SECANT	ARCSECH(X)=LOG((SQR(-X*X+1)+1)/X)
INVERSE HYPERBOLIC COSECANT	ARCCSCH(X)=LOG((SGN(X)*SQR(X*X+1)+1)/X)
INVERSE HYPERBOLIC COTANGENT	ARCCOTH(X)=LOG((X+1)/(X-1))/2

NIXDORF COMPUTER

I N D E X

A

B

C

9

C

D

I N D E X

E

F

G

H

I

K

NIXDORF COMPUTER

INDEX

L

M

9

INDEX

I N D E X

P

R

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I N D E X

S

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U

NIXDORF COMPUTER

I N D E X

V

W

9