APPENDIX A
ASCII Character Set

Graphic	Decimal Value	Comments
	0	Null
	1	Start of heading
	2	Start of text
	3	End of text
	4	End of transmission
	5	Enquiry
	6	Acknowledge
	7	Bell
	8	Backspace
	9	Horizontal tabulation
	10	Line feed
	11	Vertical tabulation
	12	Form feed
	13	Carriage return
	14	Shift out
	15	Shift in
	16	Data link escape
	17	Device control 1
	18	Device control 2
	19	Device control 3
	20	Device control 4
	21	Negative acknowledge
	22	Synchronous idle
	23	End of transmission block
	24	Cancel
	25	End of medium
	26	Substitute
	27	Escape
	28	File separator
	29	Group separator
	30	Record separator
	31	Unit separator
	32	Space
!	33	Exclamation point
"	34	Quotation mark

Graphic	Decimal Value	Comments
#	35	Number sign
$	36	Dollar sign
%	37	Percent sign
&	38	Ampersand
'	39	Apostrophe
(	40	Opening parenthesis
)	41	Closing parenthesis
*	42	Asterisk
+	43	Plus
,	44	Comma
-	45	Hyphen (Minus)
.	46	Period (Decimal)
/	47	Slant
0	48	Zero
1	49	One
2	50	Two
3	51	Three
4	52	Four
5	53	Five
6	54	Six
7	55	Seven
8	56	Eight
9	57	Nine
:	58	Colon
;	59	Semicolon
<	60	Less than
=	61	Equals
>	62	Greater than
?	63	Question mark
@	64	Commercial at
A	65	Uppercase A
B	66	Uppercase B
C	67	Uppercase C
D	68	Uppercase D
E	69	Uppercase E
F	70	Uppercase F
G	71	Uppercase G
H	72	Uppercase H
I	73	Uppercase I
J	74	Uppercase J
K	75	Uppercase K
L	76	Uppercase L
M	77	Uppercase M
N	78	Uppercase N
O	79	Uppercase O
P	80	Uppercase P
Q	81	Uppercase Q
R	82	Uppercase R

Graphic	Decimal Value	Comments
S	83	Uppercase S
T	84	Uppercase T
U	85	Uppercase U
V	86	Uppercase V
W	87	Uppercase W
X	88	Uppercase X
Y	89	Uppercase Y
Z	90	Uppercase Z
[	91	Opening bracket
\	92	Reverse slant
]	93	Closing bracket
^	94	Circumflex
_	95	Underscore
`	96	Grave accent
a	97	Lowercase a
b	98	Lowercase b
c	99	Lowercase c
d	100	Lowercase d
e	101	Lowercase e
f	102	Lowercase f
g	103	Lowercase g
h	104	Lowercase h
i	105	Lowercase i
j	106	Lowercase j
k	107	Lowercase k
l	108	Lowercase l
m	109	Lowercase m
n	110	Lowercase n
o	111	Lowercase o
p	112	Lowercase p
q	113	Lowercase q
r	114	Lowercase r
s	115	Lowercase s
t	116	Lowercase t
u	117	Lowercase u
v	118	Lowercase v
w	119	Lowercase w
x	120	Lowercase x
y	121	Lowercase y
z	122	Lowercase z
{	123	Opening (left) brace
|	124	Vertical line
}	125	Closing (right) brace
~	126	Tilde
	127	Delete

APPENDIX B
Error Messages

Four types of errors may cause error messages: command errors, statement syntax errors, compile errors, and run errors resulting from program execution.

Command Errors

Command error messages are printed following the command that caused the error. If the message is preceded by the word "WARNING:", the command is accepted. Otherwise, the command will be dropped and must be entered again.

Syntax Errors

When a syntax error in a statement is detected, the following message is printed:

ERROR@*integer*

where *integer* is the number of non-blank characters successfully processed before the error was detected. The user may type a carriage return and enter the statement correctly, or he may type any other character to request printing of the syntax error message. If the message is preceded by the word "WARNING:", the line is accepted and need not be re-entered.

Compile Errors

These errors are detected following a RUN command but before execution of the program. If the error message is preceded by the word "WARNING:", compilation continues. If compilation results in no message or only WARNING messages, the program will be executed. Otherwise, compilation terminates with no attempt to run the program.

Whenever possible, the line number in which the error occurred will be appended to the message in the form: IN LINE *n* DETECTED IN LINE *n* or DETECTED AT END, whichever is pertinent.

Compile messages will be printed during a run if a compile error is detected in a subprogram called by CHAIN or INVOKE. The message is printed before execution of the program.

Run Errors

These errors are detected during program execution and printed as they occur. If the error message is preceded by the word "WARNING:", the run continues. Otherwise, the run terminates. WARNING messages may be suppressed during a run by including the NOWARN parameter in the RUN command (see Section II).

The line number where the error occurred will be appended to most run error messages in the form: IN LINE *n*, where *n* is the line number. If the program is named, this message is followed by IN *programname.*

The WARNING messages for run errors generally are in response to arithmetic errors such as underflow, overflow, division by zero, and so forth. In each of these cases, BASIC/3000 will automatically assign a result. This result is printed as part of the message. For instance, for integer overflow the result is ±32767, for all other overflow the result is ±1E77, for division by zero the result is ±1E77, and for underflow the result is zero.

APPENDIX C
BNF Syntax for BASIC/3000

The Backus-Naur Form (BNF) syntax is used to describe the BASIC/3000 language. BNF notation consists of a number of "productions", each of which has the form:

<entity> : : = <expression>

where the syntactic entity on the left side is defined by or may be replaced by the syntactic expression on the right side. The expression may be a sequence of syntactic terms or several of these sequences separated by the character "|". When more than one sequence appears, it means that the entity may be replaced by one, and only one, of the sequences of syntactic terms.

The following additions have been made to the standard BNF for simplicity and conciseness:

- Brackets ("[" and "]") surrounding an expression indicate that the expression is optional.
- Braces (" { " and " } ") surrounding an expression are used to indicate that the expression is to be considered as a single term. Brackets are also used in this way.
- An ellipsis ("...") following a term indicates that the term may be repeated indefinitely.
- A symbol whose name has the form <something list> has an implied definition of <something>[,<something>]... unless stated otherwise.

<constant> : : = [<sign>] {<integer> | <fixed> | <float> | <long>}

<sign> : : = + | -

<unsigned constant> : : = <integer> | <fixed> | <float> | <complex> | <long>

<integer> : : = <digit> ...

<digit> : : = 0|1|2|3|4|5|6|7|9

<fixed> : : = <integer>. | .<integer> | <integer>.<integer>

<float> : : = <numpart> E [<sign>] <integer9

<numpart> : : = <integer> | <fixed>

<complex> : : = (<number part>, <number part>)

<number part> : : = [<sign>] {<integer> | <fixed> | <float>}

<long> : : = <numpart> L [<sign>] <integer>

<variable> : : = <numeric variable> | <string variable>

<numeric variable> : : = <simple variable> | <subscripted variable>

<simple variable> : : = <letter> [<digit>]

<letter> : : = A| B| C| D| E| F| G| H| I| J| K| L| M| N| O| P| Q| R| S| T| U| V| W| X| Y| Z

<subscripted variable> : : = <numeric array id> (<sublist>)

<numeric array id> : : = <letter> [<digit>]

<sublist> : : = <subscript> [,<subscript>]

<subscript> : : = <integer expression>

<integer expression> : : = <numeric expression having an integer value, possibly by conversion from a real, long, or complex value>

<expression> : : = <numeric expression> | <string expression>

<numeric expression> : : = <conjunction> [OR<conjunction>]...

<conjunction> : : = <relation> [AND<relation>]...

<relation> : : = <minmax> [<relational operator><minmax>]... | <string expression><relational operator><string expression>

<minmax> : : = <sum> [{ MIN | MAX } <sum>]...

<sum> : : = <unary sign> <term> [{ + | - } <unary sign> <term>]...

<term> : : = [NOT <unop>] <factor> [{ * | / | MOD } <unop> <factor>]...

<factor> : : = <primary> [{ ** | ^ } <unop> <primary>]...

<unop> : : = [+ | - | NOT]...

<unary sign> : : = [+ | -]...

<primary> : : = <numeric variable> | <unsigned constant> | <numeric function reference> | (<numeric expression>)

<relational operator> : : = < | < = | = | <> | > | > = | #

<numeric function reference> : : = <numeric built-in function name> (<argument list>) |
<numeric user-defined function name> (<actual parameter list>)

<numeric built-in function name> : : = <name of any BASIC/3000 built-in function that
returns a numeric value>

<argument> : : = <numeric expression> | <string expression> |
<numeric array id> | <string array id> |

<actual parameter> : : = <expression> | <string simpvar id> (*) |
<numeric array id> { (*) | (*,*) } | <string array id> (*,*)

<string expression> : : = <source string> [+<source string>]...

<source string> : : = <string variable> | <literal string> | <string function reference>

<string variable> : : = <string simple variable> | <string array variable>

<string simple variable> : : = <string simpvar id> [(<substring designator>)]

<string array variable> : : = <string array id> (<subscript> [,<substring designator>])

<string simpvar id> : : = <letter> [<digit>]$

<string array id> : : = <letter> [<digit>]$

<substring designator> : : = <first character position> [,<last character position>] |
<first character position>;<number of characters>

<first character position> : : = <integer expression>

<last character position> : : = <integer expression>

<number of characters> : : = <integer expression>

<literal string> : : = <quoted string> |' <integer> [<quoted string>] |
<literal string> ' <integer> [<quoted string>]

<quoted string> : : = "[<character>]..."

<character> : : = <any ASCII graphic character other than ">

<string function reference> : : = <string built-in function name> (<argument list>) |
<string user-defined function name (<actual parameter list>)

<string built-in function name> : : = <name of any BASIC/3000 built-in function that returns
a string value>

<LET statement> : : = [LET] <let part> [,<let part>]...

<let part> : : = <num let> | <string let>

<num let> : : = <num left part> <numeric expression>

<num left part> : : = { <numeric variable> = } ...

<string let> : : = <string left part> <string expression>

<string left part> : : = { <destination string> = } ...

<destination string> : : = <string variable>

<REM statement> : : = REM <character string>

<character string> : : = <any ASCII graphic character>

<GO TO Statement> : : = <single-branch GO TO> | <multibranch GO TO>

<single-branch GO TO> : : = GO TO <label>

<multibranch GO TO> : : = GO TO <integer expression> OF <label list>

<label> : : = <integer>

<GOSUB statement> : : = <single-branch GOSUB> | <multi-branch GOSUB>

<single-branch GOSUB> : : = GOSUB <label>

<multi-branch GOSUB> : : = GOSUB <integer expression> OF <label list>

<RETURN statement> : : = <gosub return> | <function return>

<gosub return> : : = RETURN

<function return> : : = RETURN <expression>

<END Statement> : : = END

<STOP Statement> : : = STOP

<FOR statement> : : = FOR <for variable> = <initial value> TO <final value> [STEP <step size>]

<NEXT statement> : : = NEXT <for variable>

<for variable> : : = <simple variable>

<initial value> : : = <numeric expression>

<final value> : : = <numeric expression>

<step size> : : = <numeric expression>

<IF body> : : = <IF part> [<ELSE part>]

<IF part> : : = <IF statement> | <IF DO statement> <DO part>

<ELSE part> : : = <ELSE statement> | <ELSE DO statement> <DO part>

<IF statement> : : = IF <numeric expression> THEN { <label> | <clause> }

<IF DO statement> : : = IF <numeric expression> THEN DO

<ELSE statement> : : = ELSE { <label> | <clause> }

<ELSE DO statement> : : = ELSE DO

<DO part> : : = [<statement>]... <DOEND statement>

<DOEND statement> : : = DOEND

<clause> : : = <any executable statement other than IF, FOR, NEXT, ELSE, or DOEND>

<PRINT Statement> : : = PRINT [<print list> [, | ;]]

<print list> : : = <print element> [{ , | ; } <print element>]...

<print element> : : = <expression> | <print function> | (<FOR statement>, <print list> [, | ;])

<print function> : : = <print function name> (<integer expression>)

<print function name> : : = TAB | LIN | SPA | CTL

<READ statement> : : = READ <read item list>

<read item list> : : = <variable> | (<FOR statement>, <read item list>)

<DATA statement> : : = DATA <data constant list>

<data constant> : : = <constant> | <literal string>

<RESTORE statement> : : = RESTORE [<label>]

<INPUT statement> : : = INPUT [[:] <input item list>] [:]

<input item> : : = <variable> | <literal string> | (<FOR statement>, <input item list>)

<ENTER statement> : : = ENTER # <terminal> |
ENTER # <terminal>, <allotment>, <time>, <variable>

<allotment> : : = <integer expression>

<terminal> : : = <numeric variable>

<time> : : = <numeric variable>

<DIM statement> : : = DIM <dimspec list>

<dimspec> : : = <numeric dimspec> | <string dimspec>

<numeric dimspec> : : = <numeric array id> (<bound> [, <bound>])

<string dimspec> : : = <string array id> (<bound>, <size>) | <string simpvar id> (<size>)

<bound> : : = <integer>

<size> : : = <integer>

<REDIM statement> : : = REDIM <redimspec> [,<redimspec>]

<redimspec> : : = <numeric redimspec> | <string redimspec>

<numeric redimspec> : : = <numeric array id>(<integer expression>[,<integer expression>])

<string redimspec> : : = <string array id> (<integer expression>)

<Type statement> : : = <type> <typespec list>

<type> : : = INTEGER | COMPLEX | LONG | REAL

<typespec> : : = <simple variable> | <numeric dimspec>

<MAT READ statement> : : = MAT READ <mat read item list>

<MAT INPUT statement> : : = MAT INPUT <mat read item list>

<mat read item> : : = <numeric array id> | <string array id> | <redimspec>

<MAT PRINT statement> : : = MAT PRINT <mat print list> [, | ;]

<mat print list> : : = <mat print item> [{ , | ; } <mat print item { , | ; }]...

<mat print item> : : = <numeric array id> | <string array id> | <print function>

<MAT initialization statement> : : = MAT <numeric array id>
=<initialization function>[(<integer expression>[,<integer expression>])]

<initialization function> : : = ZER | CON | IDN

<string MAT initialization statement> : : = MAT <string array> = NUL$(<integer expression>)

<MAT assignment statement> : : = MAT <numeric array id> = <numeric array id> |
MAT <numeric array id> = <numeric array id>+<numeric array id>|
MAT <numeric array id>=<numeric array id>-<numeric array id>|
MAT <numeric array id>=<numeric array id>*<numeric array id>|
MAT <numeric array id>=INV(<numeric array id>)|
MAT <numeric array id>=TRN(<numeric array id>)|
MAT <numeric array id>=(<numeric expression>)*<numeric array id>
MAT <string array id>=<string array id>

<CONVERT statement> : : = CONVERT <numeric expression> TO <destination string>|
CONVERT <string expression> TO <numeric variable>[,<label>]

<LINPUT statement> : : = LINPUT <destination string>

<multiline function> : : = <multiline DEF statement> <multiline function body>

<multiline DEF statement> : : = DEF[<type>]<numeric function name>(<formal parameter list>)|
DEF <string function name> (<formal parameter list>)

<multiline function body> : : = <statement> ... <FNEND statement>

<FNEND statement> : : = FNEND

<formal parameter> : : = [<type>] <variable parameter> | <string parameter>

<string parameter> : : = <string simpvar id> [(*)] | string array id> (*,*)

<variable parameter> : : = <simple variable> | <numeric array id> { (*) | (*,*) }

<numeric function name> : : = FN <letter>

<string function name> : : = FN <letter>$

<one-line DEF statement> : : = DEF[<type>]<numeric function name>(<formal parameter list>)
= <numeric expression> |
= DEF = string function name>)<formal parameter list>
= <string expression>

<CREATE statement> : : = CREATE <numeric variable>,<string expression>,
<file size> [, <record size>]

<filesize> : : = <integer expression>

<record size> : : = <integer expression>

<PURGE statement> : : = PURGE <numeric variable>,<string expression>

<FILES statement> : : = FILES <file designator list>

```
<file designator>                 :: = <qualified file name> |*| #<integer>

<qualified file name>             :: = <local file reference> [.<group name> [.<account name>] ]

<local file reference>            :: = <file name> [/<lockword>]

<ASSIGN statement>                :: = ASSIGN <string file name>, <file number>,
                                       <numeric variable> [,<protect mask>] [,<restriction>] |
                                  :: = ASSIGN *,<file number>

<string file name>                :: = <string expression>

<file number>                     :: = <integer expression<

<protect mask>                    :: = <string expression>

<restriction>                     :: = RR | WR | NR | WL | NL

<file PRINT statement>            :: = PRINT #<file number> [,<record number>] [;<print list>[,|]]|
                                       PRINT #<file number>[,<record number>];
                                       [<print list>{ ,|; } ]END

<file PRINT USING statement>      :: = PRINT#<file number>[,record number>]
                                       [;] USING { <label> |<string expression> }
                                       [;<print list>|END| { print list, END} ]

<file READ statement>             :: = READ#<file number> [,<record number>] [;<read item list>]

<record number>                   :: = <integer expression>

<ON END statement>                :: = { ON | IF } END# <file number> THEN <label>

<ADVANCE statement>               :: = ADVANCE#<file number>;<integer expression>,
                                       <numeric variable>

<UPDATE statement>                :: = UPDATE#<file number>; <expression>

<LOCK statement>                  :: = LOCK#<file number>

<UNLOCK statement>                :: = UNLOCK#<file number>

<file LINPUT statement>           :: = LINPUT#<file number> [,<record number>];
                                       <designation string>

<file RESTORE statement>          :: = RESTORE#<file number>

<file MARGIN statement>           :: = MARGIN [#<file number>,] <marginsize>

<file MAT READ statement>         :: = MAT READ#<file number> [,<record number>]
                                       [;<mat read item list>]

<file MAT PRINT statement>        :: = MAT PRINT#<file number> [,<record number>]
                                       [,<mat print list> [,|;]] |

<file MAT PRINT USING
 statement>                       :: = MAT PRINT#<file number> [,<record number>]
                                       [;] USING {<label> |<string expression> }
                                       [;<mat print list> |END| {mat print list, END} ]

<PRINT USING statement>           :: = <print using> [;<print using element list>]

<print using>                     :: = PRINT USING {<string expression> | <label>}

<print using element>             :: = <expression> | <print function> |
                                       (<FOR statement>, <print using element list>)
```

<MAT PRINT USING statement> : : = MAT <print using> [;<mat print item list>]

<IMAGE statement> : : = IMAGE <format string>

<format string> : : = [<carriage control>,] <format list>

<carriage control> : : = + | - | #

<format list> : : = [/|,] <format element> [{ / | , } <format element>]... [/|,]

<format element> : : = <format spec> | <replicator> (<format list>)

<replicator> : : = <integer>

<format spec> : : = <string spec>|<fixed spec>|<float spec>|
<integer spec>|<complex spec>|<K spec>|<literal spec>

<literal spec> : : = <lit>

<lit> : : = [<literal string> | [< replicator >] { X | I | $ }]

<string spec> : : = <lit> { [<replicator>] A <lit> } ...

<K spec> : : = <lit> K <lit>

<integer spec> : : = <unsigned integer spec> | <signed integer spec>

<unsigned integer spec> : : = <lit> { [<replicator> D <lit> } ...

<signed integer spec> : : = <lit> { S|M } <unsigned integer spec> |
<unsigned integer spec> { S|M }
[<unsigned integer spec> | <lit>]

<fixed spec> : : = <signed fixed spec> | <unsigned fixed spec>

<signed fixed spec> : : = <signed integer spec>. { <unsigned integer spec>|<lit> } |
<lit> { S|M } <lit>.<unsigned integer spec>|
{ <unsigned integer spec>|<lit> }. <signed integer spec> |
<unsigned integer spec> . <lit> { S|M } <lit>

<unsigned fixed spec> : : = <unsigned integer spec> .
{ <unsigned integer spec> | <lit> } |
<lit> . <unsigned integer spec>

<float spec> : : = <unsigned float spec> | <signed float spec>

<unsigned float spec> : : = { <unsigned integer spec> | <unsigned fixed spec> } E<lit>

<signed float spec> : : = { <signed integer spec> | <signed fixed spec> } E<lit> |
<unsigned float spec> { S|M } <lit>

<simple spec> : : = <fixed spec> | <float spec> | <integer spec>

<complex spec> : : = <lit> C (<simple spec>, <simple spec>) <lit> |
{<lit> | <simple spec>} {+ | -} {<unsigned integer spec> |
>unsigned fixed spec> | <unsigned float spec>}

<CHAIN statement> : : = CHAIN <string expression> [,<integer expression>]

<INVOKE statement> : : = INVOKE <string expression> [,<integer expression>]

<COM statement> : : = COM [(<nonzero digit>)] <com item list>

<nonzero digit> : : = 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

<com item> : : = [<type>] <numeric com item> | <string com item>

<string com item> : : = <string parameter> | <string dimspec>

<numeric com item> : : = <variable parameter> | <typespec>

<CALL statement> : : = {CALL | *} <external procedure name> [(<actual parameter list>)]

<external procedure name> : : = <the name of a procedure in the group SL, account SL,
or system SL>

<SYSTEM statement> : : = SYSTEM <numeric variable>, <string expression>

APPENDIX D
Summary of BASIC/3000 Statements and Commands

STATEMENT SUMMARY

This summary of BASIC/3000 statements provides the statement names in alphabetic order with a brief description and a reference to the section or sections containing a complete statement description.

Statement	Description	Reference
ADVANCE #	Skips the specified number of items in a forward or backward direction on a file.	Section VIII
ASSIGN	Dynamically assigns a file name to a file number and opens the file; may also be used to close files during execution.	Section VIII
CALL or *	Calls for execution of a procedure stored in a segmented procedure library (SL), optionally passing parameters to the procedure.	Section XI
CHAIN	Terminates the current program and calls for execution of the BASIC/3000 program named in the CHAIN statement. Variables are shared between programs if named in COM statements.	Section X
COM	Declares a common block to contain specified variables used in common by more than one program. Effective when one program calls another with CHAIN or INVOKE.	Section X
COMPLEX	Declares the following variable or variables to be type complex.	Section IV
CONVERT	Converts a numeric expression to a string representation, or converts a string expression to a numeric representation.	Section V
CREATE	Creates a formatted file with a specified length and, optionally, a record size.	Section VIII
DATA	Provides data to be read by READ statements.	Section II
DEF	Introduces a function definition.	Section VI

Statement	Description	Reference
DIM	Reserves storage for arrays and sets the upper bounds on the number of elements.	Section III
	DIM also reserves storage for strings and sets their maximum character length.	Section V
DO...DOEND	Used only after IF...THEN or ELSE, they enclose statements to be executed when an IF or ELSE condition is satisfied. (See IF...THEN)	Section II
ELSE	Used only in conjunction with IF...THEN, it introduces a statement to be executed when the IF condition is false. (See IF...THEN)	Section II
END	Terminates execution of the current program; may be omitted since last line of program provides an implicit END.	Section II
ENTER	Provides for user input with a timed response. Returns the actual response time and, optionally, the logical terminal number. One numeric or string constant can be input.	Section II
FILES	Allocates file numbers to file names or reserves file numbers for later assignment with ASSIGN. FILES is declarative and, unlike ASSIGN, is not executed.	Section VIII
FNEND	Terminates a multi-line function definition.	Section VI
FOR...NEXT	Allows repetition of a group of statements between FOR and NEXT. The number of repetitions is determined by the initial and final values of a FOR variable, and by an optional step specification.	Section II
GOTO	Transfers control to a specified statement label.	Section II
GOTO...OF	Multibranch GOTO transfers control to one of a list of statement labels depending on the value of an integer expression.	Section II
GOSUB	Causes execution of a subroutine beginning at a specified statement label. Following a RETURN statement in the subroutine, control returns to the statement following GOSUB.	Section II
GOSUB...OF	Multibranch GOSUB executes one of a list of subroutines depending on the value of an integer expression.	Section II
IF END #	Specifies action to be taken when an end-of-file condition occurs; IF END # is used interchangeably with ON END #.	Section VIII

Statement	Description	Reference
IF ... THEN	Evaluates a conditional expression and specifies action to be taken if condition is true. The condition is a numeric expression considered true if its value is nonzero, false if its value is zero. The action may be transfer to a statement label, a single executable statement, or a DO . . . DOEND group.	Section II
IMAGE	Provides format specifications for PRINT USING or MAT PRINT USING statements.	Section IX
INPUT	Requests user input to one or more variables by printing a ? and accepts string or numeric data from the terminal.	Section II
INTEGER	Declares the following variables or arrays to be type integer.	Section IV
INVOKE	Suspends the current program and calls for execution of a BASIC/3000 program, and returns to statement following INVOKE after execution of the invoked program. Variables are saved and files remain open; data may be passed with COM statement.	Section X
LET	Introduces assignment statement that assigns one or more values to a variable or array element. The word LET may be omitted.	Section II
LINPUT	Requests a line of input from the terminal, all of which is assigned to a single string variable.	Section V
LINPUT #	Accepts contents of a record on a data file as input to a string variable. Used only with ASCII files.	Section VIII
LOCK #	Dynamically locks file during execution; all write operations will be completed and no other user can lock that file until an UNLOCK # statement is executed.	Section VIII
LONG	Declares the following variables or arrays to be type long.	Section IV
MARGIN	Sets the length of the print line for the PRINT and MAT PRINT statements.	Section VIII
MARGIN #	Sets the length of the print line for PRINT # and MAT PRINT # statements to the specified ASCII file.	Section VIII
MAT Add	Performs array addition element by element upon arrays of identical logical size, and assigns result to another array.	Section III
MAT Copy	Copies one array into another array with at least as many elements and the same number of dimensions. Any redimensioning is automatic.	Section III
MAT Initialize	Initializes a numeric array with values specified by the functions ZER (zero), CON (ones), or IDN (identity array).	Section III
MAT INPUT	Inputs values to arrays from the terminal; optionally an array can be redimensioned.	Section III

Statement	Description	Reference
MAT Inverse	Assigns the inverse of a square array to another array using the function INV. Any redimensioning is automatic.	Section III
MAT Multiply	Performs array multiplication on an array with dimensions m by n and an array of dimensions n by p resulting in a new array with dimensions m by p.	Section III
MAT PRINT	Prints arrays by rows according to array dimensions; a semicolon after the array name will pack the rows in a line.	Section III
MAT PRINT #	Prints contents of arrays by rows in a specified file.	Section VIII
MAT PRINT USING	Prints arrays according to format specifications in MAT PRINT USING statement or in an IMAGE statement.	Section IX
MAT PRINT # USING	Prints arrays to a specified ASCII file according to format specifications given in the MAT PRINT # USING statement or in an IMAGE statement.	Section IX
MAT READ	Reads data from DATA statements into one or more arrays.	Section III
MAT READ #	Reads data from a file into one or more arrays.	Section VIII
MAT Scalar Multiply	Multiplies each element in an array by a specified numeric expression. Any redimensioning is automatic.	Section III
MAT Subtract	Performs array subtraction element by element upon arrays of identical logical size, and assigns result to another array.	Section III
MAT Transpose	Transposes an n by m array to an m by n array using the function TRN. Any redimensioning is performed automatically.	Section III
NEXT	Terminates a loop introduced by a FOR statement. Specifies a variable that must match the FOR variable.	Section II
ON END #	Specifies action to be taken when an end-of-file condition occurs.	Section VIII
PRINT	Prints the contents of a list of numeric or string expressions on the list device.	Section II
PRINT #	Outputs the contents of a list of numeric or string variables to the specified file.	Section VIII
PRINT USING	Prints the contents of a list of numeric or string variables with format controlled by format specifications included in the PRINT USING statement or in an IMAGE statement.	Section IX
PRINT # USING	Prints the contents of a list of items to a specified ASCII file according to format specifications given in the PRINT # USING statement or in an IMAGE statement.	Section IX
PURGE	Purges a specified file from the system.	Section VIII
READ	Assigns constants and string literals from one or more DATA statements to the variables specified in READ. Treats contents of all DATA statements as a single data list.	Section II

Statement	Description	Reference
READ #	Reads one or more items from a file into specified variables.	Section VIII
REAL	Declares the following variables and arrays to be type real. This type declaration is not generally required because the real representation is the default case.	Section IV
REDIM	Redimensions the rows and columns of an array.	Section III
	Redimensions the size of a string array without changing the element size.	Section V
REM	Introduces remarks and comments in the program listing.	Section II
RESTORE	Resets the data pointer to the beginning of the program or to the first DATA statement following a specified label.	Section II
RESTORE #	Repositions the file pointer to the start of the file; can only be used on files that can be rewound.	Section VIII
RETURN	Returns control from a GOSUB subroutine to the statement following the last GOSUB.	Section II
	Terminates execution of a multiline user-defined function and returns the value of the function.	Section VI
STOP	Terminates execution of the run.	Section II
SYSTEM	Dynamically executes an MPE/3000 command from a BASIC/3000 program.	Section XI
UNLOCK #	Unlocks a file that was locked with LOCK # enabling other programs to lock and/or write on that file.	Section VIII
UPDATE #	Modifies one item in a file without affecting other items.	Section VIII

COMMAND SUMMARY

Each command is listed by name in alphabetical order followed by a brief description and a reference to the section or sections containing a complete description of the command.

Command	Description	Reference
ABORT	Legal only in break period; terminates the suspended program and returns to BASIC/3000 control where all commands are legal.	Section VII
APPEND	Appends a specified program to the end of the current program.	Section II
> BASIC	Interrupts input requested by INPUT or ENTER and enters a new level of BASIC/3000.	Section II
BREAK	Specifies breakpoints where execution of program will be interrupted to enter debugging commands.	Section VII
CALLS	Legal only in break period; lists functions and programs called by INVOKE that have not been completed.	Section VII
CATALOG or CAT	Lists name, type, file size, and record size of programs and files in the specified fileset.	Section II
CREATE	Creates a BASIC/3000 formatted file with a specified length, and optionally, record size.	Section VIII
DELETE or DEL	Deletes one or a range of more than one statement from current program.	Section II
DUMP	Displays the contents of a BASIC/3000 formatted file at the terminal or on a specified ASCII file.	Section VIII
> EOD	Terminates batch input.	Section XII
EXIT	Terminates the current BASIC/3000 program.	Section I
FILES	Legal only in break period; lists all files for the executing program.	Section VII
GET	Gets the specified BASIC/3000 program from the user's library, replacing the current program.	Section II
GO	Legal only in break period; terminates the debugging mode and resumes the suspended program. RESUME may be used wherever GO is used.	Section VII
KEY	Returns from TAPE mode to terminal mode.	Section XII
LENGTH OR LEN	Prints the number of words in the current program.	Section II

Command	Description	Reference
LIST	Lists the contents of the current program at the terminal or on a specified ASCII file.	Section II
NAME	Assigns a name to the current program.	Section II
PUNCH	Punches a program on paper tape and inserts control characters as needed to read the tape.	Section XII
PURGE	Deletes the specified data or program file from the system.	Section II Section VIII
RENUMBER or RENUM	Renumbers any group of statements in the current program, optionally from a new first line number with a specified increment. By default, renumbering starts at 10 with increments of 10.	Section II
RESUME	Resumes normal BASIC/3000 operation following a SYSTEM command break, pressing Y^{C}, or a debugging break.	Section I Section VII Section XI
RUN	Executes the current program or gets and executes a specified program file in a library.	Section II
SAVE	Saves the current program as a program file in a library.	Section II
SCRATCH or SCR	Deletes entire current program and its name. Clears all break points and traces.	Section II
SET	Legal only in break period; sets any program variable to a constant value.	Section VII
SHOW	Legal only in break period; lists the values of the specified items.	Section VII
SPOOL	Reads paper tapes that have not been punched with X-OFFs.	Section XII
SYSTEM	Suspends BASIC/3000 and transfers control to MPE/3000; the RESUME command returns control to BASIC/3000.	Section I Section XI
TAPE	Reads paper tapes that have been punched with X-OFFs.	Section XII
TRACE	Traces variable and array values, and the execution of statements and segmented programs.	Section VII
UNBREAK	Deletes any or all breakpoints specified with the BREAK command.	Section VII
UNTRACE	Deletes tracing specified by TRACE command.	Section VII
WAIT	Suspends the BASIC Interpreter.	Section VII
XEQ	Inputs commands and program statements from a specified file; the end-of-file terminates XEQ.	Section XII

APPENDIX E
Built-In Functions

A set of built-in (or predefined) functions is available for reference by the BASIC/3000 user. These functions with their class and meaning are listed below in alphabetic order. If usage is described in this manual, a section number follows the description. Built-in functions are separated into eight classes. The function result (numeric type or string) is based on the class of the function and the argument type. The table below shows the type of the result based on the function class and argument type:

Function Class	Type of Argument: INTEGER/REAL	LONG	COMPLEX	STRING
1	REAL	LONG	REAL	–
2	REAL	LONG	COMPLEX	–
3	COMPLEX	COMPLEX	COMPLEX	–
4	REAL	REAL	REAL	–
5	STRING	STRING	STRING	–
6	–	–	–	REAL
7	–	–	–	STRING
8	argument is an array or string array, result is real			

Note that an argument for a trigonometric function must be expressed in radians with 1 radian equal to $\frac{180}{\pi}$ or 57.1958 degrees.

A variable argument is shown by a capital letter, an expression by a lower-case letter.

Name and Parameters	Class	Meaning
ABS(x)	1	Absolute value of x: when x is complex: ABS(x) = SQR(REA (x)**2+IMG (x)**2)
ATN(x)	1	Arctangent x; when x is complex, the result is the angular argument of x, or $\tan^{-1}$(IMG(x)/REA(x)) adjusted to the appropriate quadrant. x is expressed in radians.
BRK(x)	4	Allows programmatic control of breaks; use with caution. If x < 0, returns current setting only. If x = 0, > BASIC, the break key, and Y^C break are disabled. If x > 0, these functions are enabled. BRK returns 0 if traps were previously disabled or 1 if they were enabled.
BUF(x)	4	Test input buffer for : option of INPUT. For this function, x is a dummy parameter. (Section II)
CEI(x)	1	Ceiling of x; smallest integer > = x. When x is complex, only the real part is used.
CHR$(x)	5	Generates a one-character ASCII string; x is in the range 0-255. (Section V).
CNJ(x)	3	Complex conjugate of x; that is, it reverses the sign of the imaginary part of x. (Section IV).
COL(A)	8	Number of columns in array A. If A is one-dimensional, COL(A)=1. (Section III).
COS(x)	2	Cosine of x; x must be expressed in radians.
CPX(x,y)	3	Complex number = x + yi. If x or y is complex only the real part is used. (Section IV).
CPU(x)	4	Number of seconds of CPU time (± .001 sec.) that the program has run.
CSH(x)	2	Hyperbolic cosine of x; CSH(x) is $(e^x + e^{-x})/2$.
DAT$(x,y)	5	Generates date string. x,y selects substring: String Position 1-3 6-11 14-17 20-27 Contents Day Date Year Time Time is expressed as hours 0-12, minutes 0-59. (Section V).
DEB$(s)	7	Returns s with leading and trailing blanks removed. (Section V).
EXP(x)	2	e^x
IMG(x)	4	Imaginary part of x. (Section IV).

Name and Parameters	Class	Meaning
INT(x)	1	Largest integer $<=$ x. If x is complex, only the real part is used.
ITM(x)	4	Number of data items between the beginning of the current record of file x and the position of the file pointers. (Section VIII).
LEN(s)	6	Logical length of string expression s. (Section V).
LOG(x)	2	Natural logarithm ($\log_e x$). If x is complex, it must not be zero. If x is not complex, it must be greater than zero.
NUM(s)	6	ASCII code for first character of string expression s. (Section V).
PIX(x)	2	PI function = $\pi * x$
POS(s_1,s_2)	6	Smallest integer representing starting position in s_1 of substring identical to s_2. If no such substring, then equals zero. (Section V).
REA(x)	4	Real part of x. (Section IV).
REC(x)	4	Current record number of file x. (Section VIII).
ROW(A)	8	Number of rows in array A. If A is one-dimensional, it returns the dimension. (Section III).
RND(x)	4	Pseudo-random number between 0 and 1 but not equal 1. If $x >= 0$, the number is determined from the previous random number, except on the first call when an unpredictable (totally random) number is generated. If $x < 0$, the random number is determined by x. To generate a repeatable sequence of random numbers make the first call with $x < 0$, and subsequent calls with $x >= 0$. To repeat the sequence, use the value of x from the first call. To generate a non-repeatable sequence, use $x >= 0$ for all calls, including the first.
SGN(x)	4	Sign function; equals 1 for $x > 0$, 0 for $x = 0$, and -1 for $x < 0$.
SIN(x)	2	Sine x; x must be expressed in radians.
SNH(x)	2	Hyperbolic sine x; SNH(x) is $(e^x - e^{-x})/2$.
SQR(x)	2	Square root of x; x must be $>= 0$.
TAN(x)	2	Tangent x; x must be expressed in radians.
TNH(x)	2	Hyperbolic tangent x; TNH(x) is SNH(x)/CSH(x).
TIM(x)	4	Time, where the value is determined by x: if $x < 0$, number of seconds since program began $x = 0$, current minute (0-59) $x = 1$, current hour (0-23) $x = 2$, current day (1-366) $x >= 3$, current year (0-99)

Name and Parameter	Class	Meaning
TYP(x)	4	Returns type of next data item in file | x |, or in DATA list if x = 0. (Section VIII).
UND(X)	4	X must be a numeric variable, UND(X) returns 1 if X has undefined value, 0 otherwise.
UPS$(s)	7	Upshift alphabetic lower case to upper case in string expression s. (Section V).
WRD(s_1,s_2)	6	Smallest integer representing starting position in s_1 of a substring that is surrounded by non-alphabetic characters and is identical to s_2. If there is no such substring, 0 is returned. (Section V).

APPENDIX F
Parameter Format

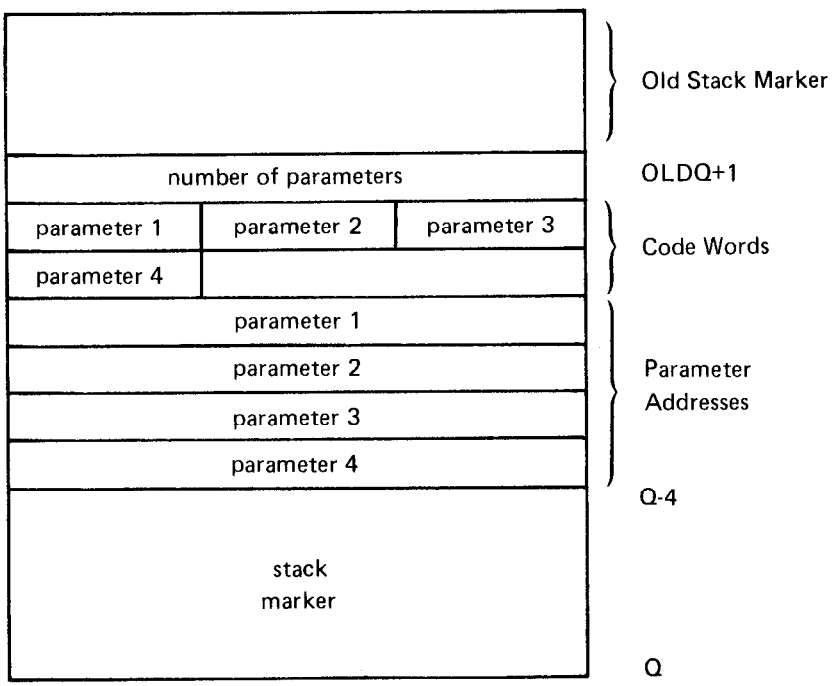
When parameters are specified in the CALL statement, the BASIC/3000 Interpreter sets up a table of the parameter addresses with a pointer to the first address. The parameter addresses are preceded by a code word for each parameter to specify the data type and whether the parameter is simple numeric, string, or an array. This enables the procedure to check if the calling sequence is correct.

The addresses point to the parameter values. These values are stored differently depending on the type of the parameter.

The user who writes the SPL or FORTRAN procedures that he calls from BASIC needs to know the format of the parameter table and also how the values are stored.

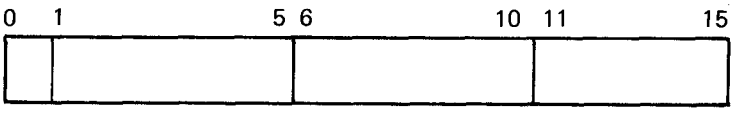
PARAMETER ADDRESS TABLE

This sample table is in the HP 3000 data stack. It contains the number of parameters, a code word for each parameter, and the parameter addresses:

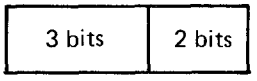


The user should refer to the HP 3000 Computer System Reference Manual for details on stack operation.

Each code word has three fields of five bits each:



Each field has two subfields of three and two bits each:



The three-bit field gives the data type of the parameter:

0 - string
1 - integer
2 - real
3 - long
4 - complex

The two-bit field specifies:

0 - simple numeric
1 - simple string or one-dimensional numeric array
2 - two-dimensional numeric array or one-dimensional string array

The code words in the stack following the procedure call are in the same order as the parameter addresses that follow.

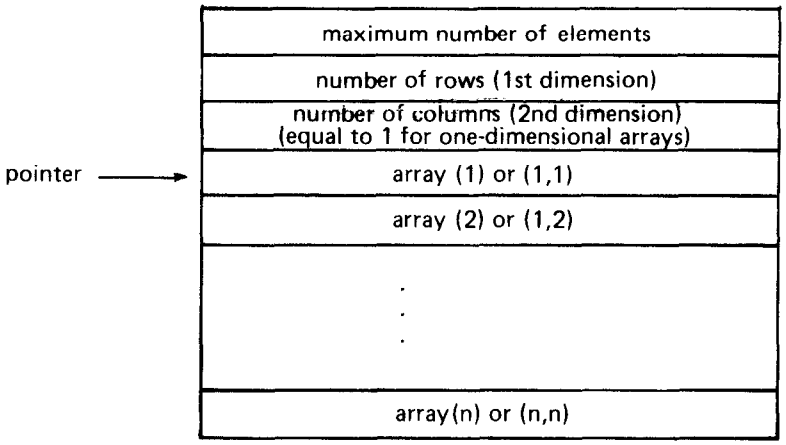
PARAMETER STORAGE

What the parameter address points to depends on the type of the parameter; whether it is simple numeric, numeric array, simple string, or string array:

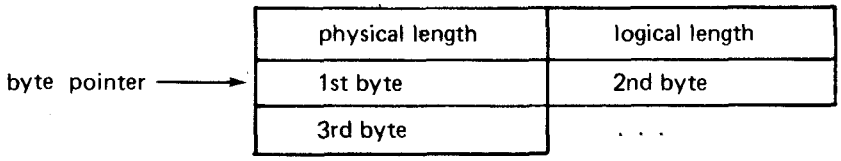
1. For a simple numeric expression, including simple variables and subscripted variables, the address points to the first word of the value. The number of words needed for a value depends on the data type:

   integer - 1 word
   real - 2 words
   long - 4 words
   complex - 4 words

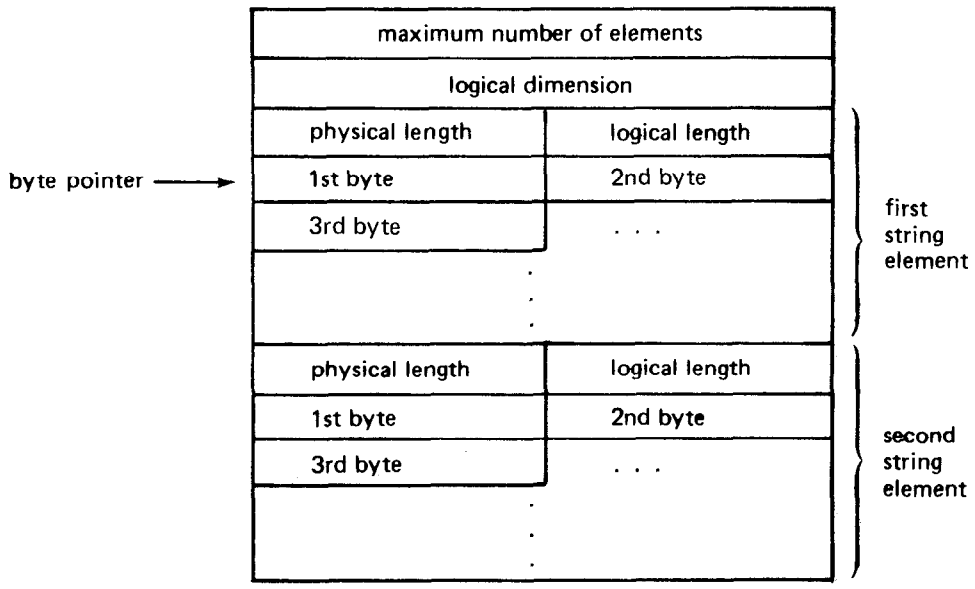
2. For numeric arrays, the address points to the first value of the array (array(1) or array(1,1)). There are three words prior to this value that describe the array. Arrays are stored by rows as follows:



3. For simple string variables, string array elements, and string expressions, the address is a byte pointer that points to the first byte of the string. The two preceding bytes define the physical and logical lengths of the string:



4. For string arrays, the address points to the first element of the array. Each element has the form of a string value with two bytes specifying physical and logical length respectively, followed by the bytes containing the actual value. This string value is preceded by two words that define the array:



APPENDIX G
Compatibility Between BASIC/2000 and BASIC/3000

With four exceptions, BASIC/2000 is a compatible subset of BASIC/3000. This means that a BASIC/2000 program can be run under control of the BASIC/3000 Interpreter and will compile and execute correctly. But, due to the many new features available in BASIC/3000, a BASIC/3000 program will not necessarily run on a BASIC/2000 system.

The four exceptions to compatibility are described here. None of these exceptions will affect compilation, but they might affect the result when a BASIC/2000 program is run on BASIC/3000.

The exceptions are:

	BASIC/3000	BASIC/2000
1.	A COM statement is valid during one run only. It does not remain valid between runs. COM blocks must have compatible structure.	A COM statement remains valid between runs. COM blocks need not have compatible structure.
2.	Files are closed when a program calls a program with the CHAIN statement.	Files remain open when a program calls a program with the CHAIN statement.
3.	MAT PRINT prints a one-dimensional array as a row of elements, thereby saving space and printing time.	MAT PRINT prints a one-dimensional array as a column of elements.
4.	S or M is required in a floating point specification of a format string if the number is negative.	S or M is not required.

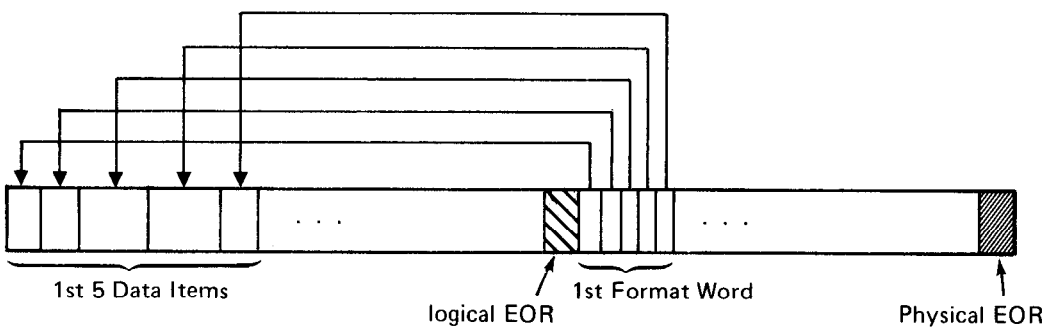
APPENDIX H
File Structure

BASIC/3000 FORMATTED FILES

A formatted BASIC/3000 file contains format words provided by the Interpreter to indicate the type of the data items in the file. Space for these format words is allocated automatically in addition to the record size specified by the user. The format words are placed in each record following the logical end-of-record, but before the physical end-of-record.

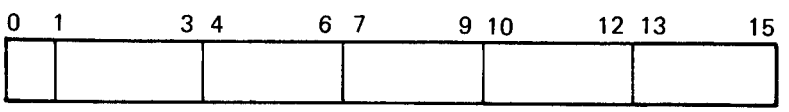
Formatted files can have a record size between 4 and 319 words. The recommended (and default) record size is 106 words per record since this yields 128 words when the format words are added. The standard system size for records is 128 words. Records are numbered starting with 1, not 0.

Each record consists of an area for data items and an area for format words:



Format Word

Each format word consists of five 3-bit flags. The first bit is not used.



The first format word corresponds to the first five data items, with the first flag in the format word corresponding to the first data item, the second flag to the second item, and so forth.

The item types are specified in the format word flags as:

0 – end-of-file

1 – end-of-record

2 – string

3 – integer

4 – real

5 – long

6 – complex

The logical end-of-record delimits the record size specified by the user to include all the data items. The physical end-of-record delimits the BASIC-created record size that is sufficient to contain the format words as well as the data items.

Record Size

The space requirements for a data item differs depending on the data type. The number of 16-bit words required for each data type is :

Data Type	Number of Words
Integer	1
Real	2
Long	3 (MPE C)
Long	4 (MPE III)
Complex	4
String	(length +1)/2 + 1

In each case an additional 1/5 of a format word is added for each data item to provide room for the format words.

The user can determine the physical record size created for the file by BASIC from the logical record size he has used to contain his data items. The formula is :

$$P = R + INT(R/5) + 1$$

where P is the physical record size created by BASIC
R is the logical record size assigned by the user

This formula never returns a physical record size which is evenly divisible by six. If a BASIC formatted file is created through the MPE/3000 Operating system with a physical record size (in words) which is evenly divisible by six, it will not be usable by BASIC. (Note that the record size supplied with the CREATE command or statement within BASIC is the logical record size and so may be a value which is divisible by six.)

If the physical record size is known, the user can determine the logical record size of a record with another formula :

$$R = CEI(5*(P-1)/6)$$

File Attributes

The user may need to know the MPE/3000 file codes for BASIC files. These codes differ depending on how the file was saved and whether it is a program file or a BASIC file. The file code for any file can be requested with the MPE command FGETINFO.

Program File (SAVE)	1026
Program File (FAST SAVE)	1027
BASIC Formatted File	1025

Other file attributes may be obtained with the MPE command :LISTF *filename*,2

The number 2 is a code that provides detailed file information for each file listed. The *filename* may be fully qualified with the user's lockword, group, and account names.

ASCII FILES

ASCII files contain data in ASCII character code. Each 16-bit word contains two characters.

BINARY FILES

Binary files have no format words or string headers. The number of words needed for each data item depends on the type of the item, as follows:

Data Type	Number of Words
Integer	1
Real	2
Long	4
Complex	4
String	(length + 1)/2

INDEX

A

B

C

G

H

I

K

L

M

S

T

U

V

W

X

Z

Special Characters

READER COMMENT SHEET

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BASIC Interpreter
Reference Manual

30000-90026 June 1976

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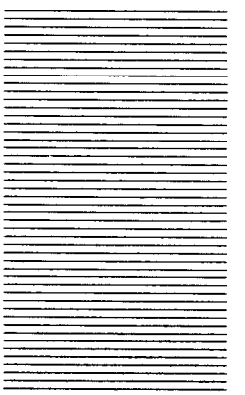

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