

SYSTEM FUNCTIONS

- EX A* Expunge or erase object(s) named by *A*, except labels or pendant functions. (*A* is an array of any rank.)
- OFF* Terminate current session
- WC* Clear entire contents of workspace

Units equipped with the Omniport* option also include:

- IN N* Accept input from peripheral device number *N* (1 to 199)
- OUT N* Direct output to peripheral device number *N* (1 to 199)

SYSTEM VARIABLES

- CT* Comparison tolerance: for the functions $< \leq \geq \neq \approx \lceil \lfloor$
- FN* Function names: An *N* by 4 matrix whose rows contain the names of functions currently in the workspace
- IO* Index origin: 0 or 1
- LC* Line counter: line numbers of functions in execution innermost first
- PP* Print precision: 2 to 16 significant digits
- PT* Print time: display latency measured in tenths of a second
- PW* Print width: 32 to 140 characters on the MCM/70 dependent on the output device
- RL* Random link: seed for generating random numbers
- SI* State indicator: *N* by 4 matrix whose rows contain the names of functions in execution—innermost first
- VA* Variable names: *N* by 4 matrix whose rows contain the names of global variables, plus local variables and labels of executing functions
- WA* Workspace available

TAPE RELATED FUNCTIONS

General

- IO* *XI N* Initialize or re-initialize tape (*N* is 0 or 1)
- XN* 10 List group numbers on tape
- XN N* List names of contents of group *N*
- XP* 10 Close tape

EASY

- N* *XD A* Delete object(s) named in array *A* from group *N*
- N* *XR A* Read object(s) named in array *A* from group *N*
- N* *XW A* Write object(s) named in array *A* in group *N*

AVS

- XA A* Append the object name(s) contained in array *A* to the directory of group 0
- N* *XC A* Append the object name(s) contained in array *A* to the directory of group *N* (1 to 255)
- XS N* Activate AVS, group 0 and group *N*
- XY* indicate if AVS, and which group, is active

ERROR MESSAGES

- DOMAIN ERROR* Function not defined for given values of the arguments
- INDEX ERROR* Indexing a non-existing dimension of an array
- LENGTH ERROR* Operation asked to be performed on arrays with nonconformable coordinate lengths
- RANGE ERROR* The result of the function performed cannot be represented
- RANK ERROR* Nonconforming or inappropriate array structure
- SYNTAX ERROR* Missing argument
- Unbalanced parentheses
- Two juxtaposed variables with no operator
- Uneven number of quotation marks
- TAPE ERROR* Cannot access the tape cassette
- VALUE ERROR* Reference to an undefined variable
- WS FULL* Instructions required more workspace than is available



MCM/APL

PRIMITIVE FUNCTIONS

SCALARS

Monadic

Dyadic

+Y	Y	X+Y	X plus Y
-Y	0-Y	X-Y	X minus Y
*Y	Signum Y	X*Y	X times Y
÷Y	Reciprocal of Y	X/Y	X divided by Y
*Y	e to the Yth power	X^Y	X to the Yth power
[Y	Ceiling of Y	X Y	Maximum of X and Y
[Y	Floor of Y	X Y	Minimum of X and Y
Y	Absolute value of Y	X Y	X-residual of Y
⊙Y	Natural logarithm of Y	X⊙Y	Base- <i>Y</i> logarithm of Y
!Y	Factorial Y	X!Y	Binomial coefficient: Y items taken X at a time
⊙Y	Pi times Y	X⊙Y	See trigonometric functions
?Y	A random number from 1 to Y	X<Y	X less than Y
~Y	Not Y	X≤Y	X less than or equal to Y
		X=Y	X equal to Y
		X>Y	X greater than or equal to Y
		X>Y	X greater than Y
		X≠Y	X not equal to Y
		XVY	X or Y
		XAY	X and Y
		XVY	Neither X nor Y
		XAY	Not both X and Y (X nand Y)

TRIGONOMETRIC FUNCTIONS

Y is in radians

1⊙Y	Sine Y	1⊙Y	Arcsin Y
2⊙Y	Cosine Y	2⊙Y	Arccos Y
3⊙Y	Tangent Y	3⊙Y	Arctan Y
4⊙Y	$(1+Y^2)^*.5$	4⊙Y	$(-1+Y^2)^*.5$
5⊙Y	Sinh Y	5⊙Y	Arcsinh Y
6⊙Y	Cosh Y	6⊙Y	Arccosh Y
7⊙Y	Tanh Y	7⊙Y	Arctanh Y
8⊙Y	$(1-Y^2)^*.5$		

MIXED

⊙Y	Dimension of Y
X⊙Y	Reshape Y to have dimension(s) X
X!Y	First Y consecutive integers from origin (0 or 1)
X!Y	First location(s) of Y within vector X
X[Y]	Yth element(s) of X
X<Y	Membership of X in Y
X!Y	Representation of Y in number system X
X!Y	Value of the representation Y in number system X
X?Y	X integers selected randomly without replacement from origin to Y
⊕[NY]	Reversal along the Nth dimension of Y
⊙Y	Reversal along the first dimension of Y
X⊕[NY]	Rotation by X along the Nth dimension of Y
X⊙Y	Rotation by X along the first dimension of Y
⊙Y	Transpose Y
X⊙Y	Transpose Y according to X
.Y	Ravel Y (make Y a vector)
X.[NY]	Catenate Y to the Nth dimension of X
X!Y	Catenate Y to the first dimension of X
X+Y	Take first or last X elements of Y as X is + or -
X+Y	Drop first or last X elements of Y as X is + or -
ΔY	Indices of values of the vector Y sorted in ascending sequence
∇Y	Indices of values of the vector Y sorted in descending sequence
±Y	Evaluate the literal vector Y as an APL statement
X=Y	Ignore Y; result is X
X+Y	Format numeric array Y according to X

GENERALIZED SCALAR DYADIC

In the entries below, the symbol ⊙ (not an APL symbol) represents any scalar dyadic function.

X⊙⊙Y	Generalized inner product of X and Y
X⊙.⊙Y	Generalized outer product of X and Y
⊙/Y	Generalized reduction along the last dimension of Y
⊙/[NY]	Generalized reduction along the Nth dimension of Y
⊙Y	Generalized reduction along the first dimension of Y
⊙Y	Generalized scan along the last dimension of Y
⊙\NY	Generalized scan along the Nth dimension of Y
⊙Y	Generalized scan along the first dimension of Y

COMPRESSION AND EXPANSION

X/Y	(logical) compression along the last dimension of Y
X/[NY]	(logical) compression along the Nth dimension of Y
X/Y	(logical) compression along the first dimension of Y
X/Y	(logical) expansion along the last dimension of Y
X\NY	(logical) expansion along the Nth dimension of Y
XAY	(logical) expansion along the first dimension of Y

SYMBOLS

()	Parentheses for nesting
→	Branch
←	Assign date to a variable
□	Quad for input and output
▢	Quote-quad for literal input
'	Quote for literal data
⋈	Comment indicator
⊖	Del for mode change
~	Negative sign
⊖	Exponential notation
.	Period or decimal point
:	Label separator
;	Output and index separator
\$	Dollar sign
_	Underline
⊞	Cursor
⊞	Computer response indicator
⊞	Length of displayed line exceeds screen width
⊞	Additional rows of array being displayed await viewing

SPECIAL KEYS

START	Begin session
CTRL and +	Return control to user as soon as evaluation of current line is complete
CTRL and +	Return control to user immediately
RETURN	Return control to computer
CTRL-SPACE	Insert space(s) within displayed statement
CTRL-BKSP	Remove character(s) from displayed statement
SPACE	Retain displayed object(s) on screen until RETURN key is pressed (valid only when <i>⊞PT</i> is not set to infinity)