WANG LABORATORIES, INC.
836 NORTH STREET, TEWKSBURY, MASSACHUSETTS 01876, TEL.(617) 851-4111, TWX 710 343-6769, TELEX 94-7421

DATA SHEET

The Option 1 Matrix ROM (Read Only Memory) available on the WANG System 2200B provides fourteen built-in matrix operations (see table).

OPERATION	DESCRIPTION	EXAMPLE
MAT addition†	array = array + array	MAT A=B+C
MAT CON*	each element of array = 1	MAT A=CON
MAT equality†	array = array	MAT A=B
MAT IDN*	matrix = identity matrix	MAT A=IDN
MAT INPUT*,**	receive array elements from keyboard	MAT INPUT A,B$
MAT INV,d†	matrix = inverse of matrix d = determinant of matrix	MAT A=INV(B),D
MAT multiplication†	array = array x array	MAT A=B*C
MAT PRINT*,**	print elements of array	MAT PRINT A,B$
MAT READ*,**	array = DATA values	MAT READ A,B$
MAT REDIM*,**	redimension array	MAT REDIM A(X,Y)
MAT scalar multiplication†	array = scalar x array	MAT A=(3)*B
MAT subtraction†	array = array − array	MAT A=B−C
MAT TRN†	array = transpose of array	MAT A=TRN(B)
MAT ZER*	each element of array = 0	MAT A = ZERO

* Resultant array redimensioned explicitly (i.e., by specifying new dimensions in statement).

† Resultant array redimensioned implicitly (i.e., depends upon dimensions of arguments).

** Can be performed on alphanumeric arrays.

Operations are performed on numeric arrays according to the rules of linear algebra and can be used for the solution of systems of non-singular homogenous linear equations. Inversion of matrices can be done in significantly shorter time than is possible with BASIC programs. MAT operations on alphanumeric arrays can be used for simple and rapid I/O (input/output) and printing of alphanumeric material.

Certain rules must be followed in using the Matrix ROM.

1. Each matrix statement must begin with the word MAT.
2. Each variable used in a MAT statement must be an array variable (i.e., be subscripted). The variable may either be explicitly defined by a DIM or COM statement or be implicitly defined as a 10 by 10 array by being using initially in a MAT statement.
3. Multiple matrix operations are not permitted in a single MAT statement.
4. Arrays which contain the result of certain MAT statements are automatically redimensioned; other arrays can be redimensioned explicitly in the MAT statement (see table). A redimensioned numeric array cannot contain more elements than given in its previous definition; a redimensioned alphanumeric array cannot contain more characters than given in its previous definition.
5. A vector cannot be redimensioned as a matrix, nor can a matrix be redimensioned as a vector.

MATRIX ROM SYSTEM 2200B

Example 1:

The program inverts the 5 x 5 matrix A, and prints both the result and the determinant of A.

```
10  DIM A(5,5)
20  PRINT "ENTER ELEMENTS OF 5x5
    MATRIX"
30  MAT INPUT A
40  MAT B=INV(A),D
50  MAT PRINT B
60  REM B IS THE INVERSE OF A, D IS THE
    DETERMINANT OF A
70  PRINT "DETERMINANT=";D
```

If the input matrix is singular (i.e., non-invertible) the error message ERR 93 is displayed.

Example 2:

The program inputs a 10x10 array, a scalar, performs scalar multiplication and prints the result.

```
10  PRINT "ENTER DATA FOR A 10x10
    ARRAY"
20  MAT INPUT C
40  INPUT "ENTER SCALAR",K
50  MAT A=(K)*C
60  MAT PRINT A
```

Example 3:

This program takes as input nine alphanumeric quantities, up to 16 characters long, and prints them as a 3x3 array in zoned format.

```
10  DIM Z$ (3,3)
20  MAT INPUT Z$
30  MAT PRINT Z$
```

Example 4:

This program takes as input 100 alphanumeric quantities, each no more than four characters long, and prints them in packed format. The first element of a row always starts a new line when displayed.

```
10  MAT INPUT X$ (10,10)4
20  MAT PRINT X$;
```

SPECIFICATIONS

Speed

For most matrix operations the Matrix ROM runs about 8 to 10 times faster than equivalent BASIC programs without the MAT statement.

MAT statement	Approximate Speed for a 10x10 matrix (in seconds)
MAT A=B+C	.11
MAT A=(B)*C	.53
MAT A=B–C	.11
MAT A=INV(B),D	5.0
MAT A=TRN(B)	.02
MAT PRINT A; (to CRT)	.27
MAT A=B*C	4.2

Size

The amount of Random Access Memory (RAM) required for a given matrix can be determined by evaluating the following expressions:

$$\left[\frac{M-H}{8}\right]$$

where M = machine size (4K=4096 bytes).
H = number of housekeeping bytes in RAM (~ 700),

since eight bytes are needed for each matrix element. Take the square root of the result to find the size of a square matrix.

$$\left[\frac{M-H}{8}\right]^{1/2}$$

A 4K machine can accomodate a 20x20 matrix or a matrix of 420 elements; an 8K machine, a 30x30 matrix or a 960 element matrix.

ORDERING SPECIFICATIONS

The Option 1 Matrix ROM must be a Read Only Memory fully compatible with the WANG System 2200B. It must perform the following matrix input/output and arithmetic operations on command from MAT statements: Matrix addition, subtraction, multiplication, scalar multiplication, inversion, transposition (on numeric arrays). Matrix reading, inputting from the keyboard, printing, and redimensioning (on numeric and alphanumeric arrays). The following matrices must be created on command from MAT statements: a constant matrix (each element = 1), a zero matrix (each element = 0), and an identity matrix. Array default size must be 10x10, default element size for alphanumeric arrays must be 16 characters. Arrays must be automatically redimensioned by arithmetic matrix operations.

Standard Warranty Applies.

Wang Laboratories reserves the right to change specifications without prior notice.

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