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Matrix-Vector Multiplier Chip

General Description:

The Matrix-Vector Multiplier Chip will multiply a 3-bit x 3-bit matrix with a 3-bit vector to produce a 6-bit output. This chip utilizes a cellular array of CMOS elements, designed for easy expandability and testability. Each input pin accepts standard CMOS voltage levels. The outputs are also standard CMOS levels. For ease of testing, a sequence generator has also been added, which is accessible in test mode.

Specifications:

Supply Voltage……5V
Sink Current……?
Source Current……?
Power Dissipation……?
Fan Out……?
Propagation Delay……...10 cycles
Input Low Voltage……0-0.5V
Input High Voltage……4.5-5.0V
Output Low Voltage……0-0.5V
Output High Voltage……4.5-5.0V

Clock	1	40	Vdd
Mode	2	39	NC
NC	3	38	Y11
A1	4	37	Y10
A2	5	36	Y21
A3	6	35	Y20
NC	7	34	Y31
B1	8	33	Y30
B2	9	32	NC
B3	10	31	T1
NC	11	30	T2
C1	12	29	T3
C2	13	28	T4
C3	14	27	T5
NC	15	26	NC
X1	16	25	TC1
X2	17	24	TC2
X3	18	23	TC3
NC	19	22	TC4
Gnd	20	21	TC5

The clock pin is for a user-supplied clock input. Mode pin is 0 for normal operation and 1 for self-test operation. A1-3, B1-3, and C1-3 correspond to the inputs for the 1st, 2nd, and 3rd rows of the input matrix respectively. Pins X1-X3 correspond to the input vector. Y11 and Y10 are the bits of the 1st element of the output vector; likewise for Y21-Y20 and Y31-Y30. T1-T5 are active only in test mode. They are the outputs of each processor cell and pins TC1-TC5 are the carry bits from the processor cells.

Sample Operation

Mathematical representation of the chip's function:

$$\begin{pmatrix} A1 & A2 & A3 \\ B1 & B2 & B3 \\ C1 & C2 & C3 \end{pmatrix} \begin{pmatrix} X1 \\ X2 \\ X3 \end{pmatrix} = \begin{pmatrix} Y11 & Y10 \\ Y21 & Y20 \\ Y31 & Y30 \end{pmatrix}$$

A full truth table would be too large to include, but a couple examples are given:

Example 1:

$$\begin{pmatrix} 1 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 1 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 01 \\ 00 \\ 01 \end{pmatrix}$$

Example 2:

$$\begin{pmatrix} 1 & 1 & 1 \\ 0 & 0 & 1 \\ 1 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix} = \begin{pmatrix} 10 \\ 00 \\ 01 \end{pmatrix}$$

The truth table for these two examples would look like this:

A1	A2	A3	B1	B2	B3	C1	C2	C3	X1	X2	X3	Y11	Y10	Y21	Y20	Y31	Y30
1	1	0	0	0	1	1	1	1	1	0	0	0	1	0	0	0	1
1	1	1	0	0	1	1	0	1	1	1	0	1	0	0	0	0	1