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# 100158

## Shift Matrix

### FEATURES

- Typical propagation delay: 1.9ns
- Typical supply current ( $-I_{EE}$ ): 118mA

### DESCRIPTION

The 100158 contains a combinatorial network which performs the function of an

8-bit Shift Matrix. Three control lines ( $S_n$ ) are internally decoded to define the number of places which an 8-bit word, present at the inputs ( $D_n$ ), is shifted to the right. The shifted word appears on the outputs  $Q_n$ . A Mode Control is provided which, if Low, forces Low all outputs to the left of the one that contains  $D_7$ . This operation is sometimes referred to as low backfill. If M

is High, a circular shift is performed, such that  $D_0$  appears at the output just to the left of the one that contains  $D_7$ . This operation is commonly referred to as barrel shifting.

All unused inputs can be left open due to integrated pull-down resistors.

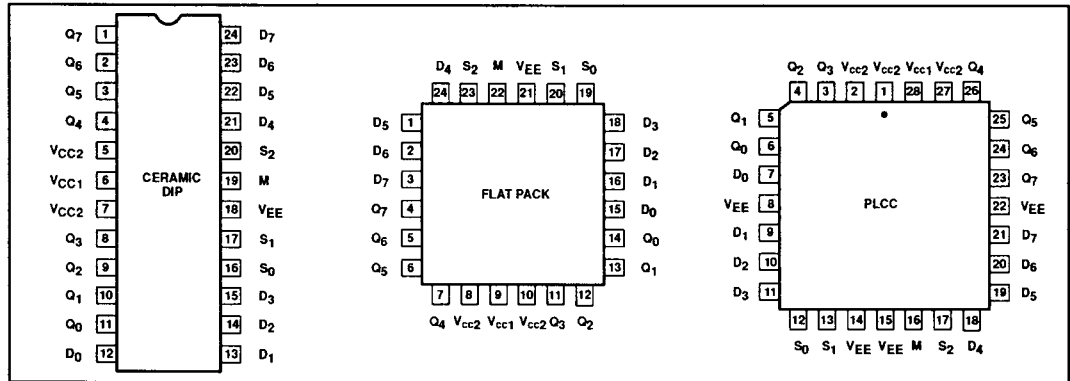
### PIN DESCRIPTION

| PINS        | DESCRIPTION        |
|-------------|--------------------|
| $D_0 - D_7$ | Data Inputs        |
| $S_0 - S_2$ | Select Inputs      |
| M           | Mode Control Input |
| $Q_0 - Q_7$ | Data Outputs       |

### ORDERING INFORMATION

| DESCRIPTION                        | ORDER CODE |
|------------------------------------|------------|
| 24-Pin Ceramic DIP (400 mils wide) | 100158F    |
| 24-Pin Ceramic Flat Pack           | 100158Y    |
| 28-Pin PLCC                        | 100158A    |

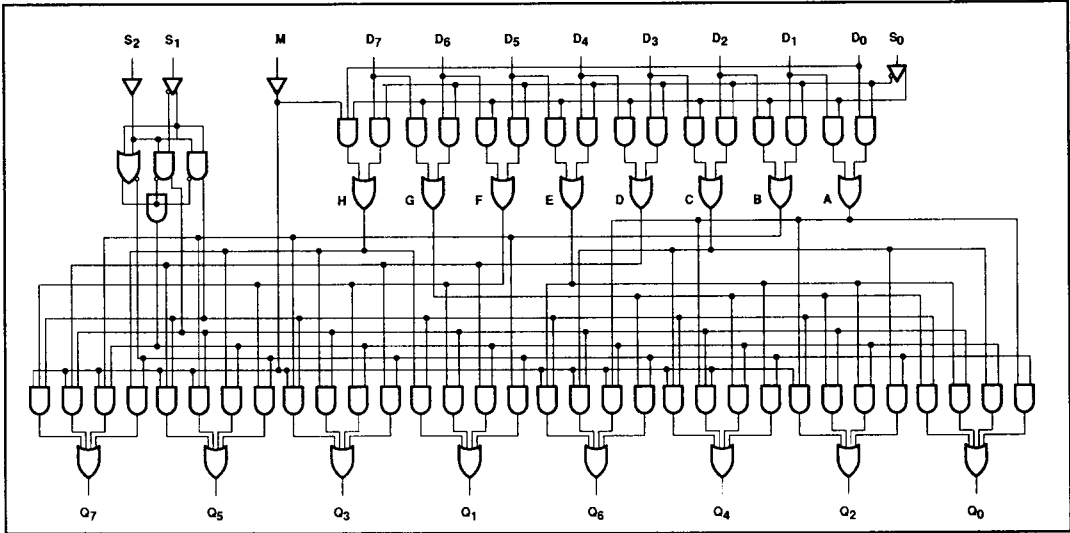
### PIN CONFIGURATIONS



Shift Matrix

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LOGIC DIAGRAM



FUNCTION TABLE

| INPUTS |                |                |                | OUTPUTS        |                |                |                |                |                |                |                |
|--------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| M      | S <sub>2</sub> | S <sub>1</sub> | S <sub>0</sub> | Q <sub>7</sub> | Q <sub>6</sub> | Q <sub>5</sub> | Q <sub>4</sub> | Q <sub>3</sub> | Q <sub>2</sub> | Q <sub>1</sub> | Q <sub>0</sub> |
| X      | L              | L              | L              | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> |
| L      | L              | L              | H              | L              | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> |
| L      | L              | L              | L              | L              | L              | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> |
| L      | L              | L              | H              | L              | L              | L              | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> |
| L      | L              | H              | L              | L              | L              | L              | L              | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> |
| L      | L              | H              | L              | L              | L              | L              | L              | L              | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> |
| L      | L              | H              | H              | L              | L              | L              | L              | L              | L              | D <sub>7</sub> | D <sub>6</sub> |
| L      | L              | H              | H              | L              | L              | L              | L              | L              | L              | L              | D <sub>7</sub> |
| H      | L              | L              | H              | D <sub>0</sub> | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> |
| H      | L              | L              | L              | D <sub>1</sub> | D <sub>0</sub> | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> |
| H      | L              | H              | H              | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> |
| H      | L              | H              | L              | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> |
| H      | H              | L              | H              | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> | D <sub>7</sub> | D <sub>6</sub> | D <sub>5</sub> |
| H      | H              | L              | L              | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> | D <sub>7</sub> | D <sub>6</sub> |
| H      | H              | H              | L              | D <sub>6</sub> | D <sub>5</sub> | D <sub>4</sub> | D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> | D <sub>7</sub> |
| H      | H              | H              | H              | L              | L              | L              | L              | L              | L              | L              | L              |

NOTES:  
H = High voltage level  
L = Low voltage level  
X = Don't care

ABSOLUTE MAXIMUM RATINGS  $V_{CC1} = V_{CC2} = \text{ground}$ ,  $T_A = 0^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  unless otherwise specified:

| SYMBOL   | PARAMETER                                                              | LIMITS           | UNIT               |
|----------|------------------------------------------------------------------------|------------------|--------------------|
| $V_{EE}$ | Supply voltage range                                                   | -7.0 to +0.5     | V                  |
| $V_{IN}$ | Input voltage ( $V_{IN}$ should never be more negative than $V_{EE}$ ) | $V_{EE}$ to +0.5 | V                  |
| $I_O$    | Output source current (continuous)                                     | -55              | mA                 |
| $T_S$    | Storage temperature range                                              | -65 to +150      | $^{\circ}\text{C}$ |
| $T_J$    | Maximum junction temperature                                           | +150             | $^{\circ}\text{C}$ |

NOTE:  
Operation beyond the limits set forth in this table may impair the useful life of the device.

## Shift Matrix

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## DC OPERATING CONDITIONS

| SYMBOL             | PARAMETER                                                         | TEST CONDITIONS  | LIMITS |      |       | UNIT |
|--------------------|-------------------------------------------------------------------|------------------|--------|------|-------|------|
|                    |                                                                   |                  | MIN.   | NOM. | MAX.  |      |
| $V_{CC1}, V_{CC2}$ | Circuit ground                                                    |                  | 0      | 0    | 0     | V    |
| $V_{EE}$           | Supply voltage                                                    |                  | -4.8   | -4.5 | -4.2  | V    |
| $V_{EE}$           | Supply voltage when operating with the 10K or the 10KH ECL family |                  | -5.7   |      |       | V    |
| $V_{IH}$           | High level input voltage                                          | $V_{EE} = -4.2V$ | -1150  |      | -880  | mV   |
|                    |                                                                   | $V_{EE} = -4.5V$ | -1165  |      |       |      |
|                    |                                                                   | $V_{EE} = -4.8V$ | -1165  |      |       |      |
| $V_{IL}$           | Low level input voltage                                           | $V_{EE} = -4.2V$ | -1810  |      | -1475 | mV   |
|                    |                                                                   | $V_{EE} = -4.5V$ |        |      | -1475 | mV   |
|                    |                                                                   | $V_{EE} = -4.8V$ |        |      | -1490 | mV   |
| $T_A$              | Operating ambient temperature range                               |                  | 0      | +25  | +85   | °C   |

## NOTE:

When operating at other than the specified  $V_{EE}$  voltages (-4.2V, -4.5V, -4.8V), the DC and AC electrical characteristics will vary slightly from their specified values.

**DC ELECTRICAL CHARACTERISTICS**  $V_{CC1} = V_{CC2} = \text{ground}$ ,  $V_{EE} = -4.8V$  to  $-4.2V$ ,  $T_A = 0^\circ\text{C}$  to  $+85^\circ\text{C}$  unless otherwise specified<sup>1,3,4</sup>

| SYMBOL           | PARAMETER                           | TEST<br>CONDITIONS <sup>2</sup>                                                   |                                                                                                                                   |                         | LIMITS |       |       | UNIT |
|------------------|-------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------|--------|-------|-------|------|
|                  |                                     |                                                                                   |                                                                                                                                   |                         | MIN.   | TYP.  | MAX.  |      |
| V <sub>OH</sub>  | High level output voltage           | Outputs<br>loaded<br>with 50Ω<br>to -2.0V<br>±0.010V                              | Inputs at V <sub>IHMAX</sub> or V <sub>ILMIN</sub>                                                                                | V <sub>EE</sub> = -4.2V | -1020  |       | -870  | mV   |
|                  |                                     |                                                                                   |                                                                                                                                   | V <sub>EE</sub> = -4.5V | -1025  | -955  | -880  | mV   |
|                  |                                     |                                                                                   |                                                                                                                                   | V <sub>EE</sub> = -4.8V | -1035  |       | -880  | mV   |
| V <sub>OHT</sub> | High level output threshold voltage |                                                                                   | Apply V <sub>IHMIN</sub> or V <sub>ILMAX</sub> to one input at a time. Other inputs at V <sub>IHMAX</sub> or V <sub>ILMIN</sub> . | V <sub>EE</sub> = -4.2V | -1030  |       |       | mV   |
|                  |                                     |                                                                                   |                                                                                                                                   | V <sub>EE</sub> = -4.5V | -1035  |       |       | mV   |
|                  |                                     |                                                                                   |                                                                                                                                   | V <sub>EE</sub> = -4.8V | -1045  |       |       | mV   |
| V <sub>OLT</sub> | Low level output threshold voltage  |                                                                                   | Apply V <sub>IHMIN</sub> or V <sub>ILMAX</sub> to one input at a time. Other inputs at V <sub>IHMAX</sub> or V <sub>ILMIN</sub> . | V <sub>EE</sub> = -4.2V |        |       | -1595 | mV   |
|                  |                                     |                                                                                   |                                                                                                                                   | V <sub>EE</sub> = -4.5V |        |       | -1610 | mV   |
|                  |                                     |                                                                                   |                                                                                                                                   | V <sub>EE</sub> = -4.8V |        |       | -1610 | mV   |
| V <sub>OL</sub>  | Low level output voltage            |                                                                                   | Inputs at V <sub>IHMAX</sub> or V <sub>ILMIN</sub> .                                                                              | V <sub>EE</sub> = -4.2V | -1810  |       | -1605 | mV   |
|                  |                                     |                                                                                   |                                                                                                                                   | V <sub>EE</sub> = -4.5V | -1810  | -1705 | -1620 | mV   |
|                  |                                     |                                                                                   |                                                                                                                                   | V <sub>EE</sub> = -4.8V | -1830  |       | -1620 | mV   |
| I <sub>IH</sub>  | High level input current            | One input under test at V <sub>IHMAX</sub> . Other inputs at V <sub>ILMIN</sub> . |                                                                                                                                   |                         |        |       | 220   | μA   |
| I <sub>IL</sub>  | Low level input current             | One input under test at V <sub>ILMIN</sub> . Other inputs at V <sub>IHMAX</sub> . |                                                                                                                                   |                         | 0.5    |       |       | μA   |
| -I <sub>EE</sub> | V <sub>EE</sub> supply current      | All inputs at V <sub>IHMAX</sub>                                                  |                                                                                                                                   |                         | 84     | 118   | 205   | mA   |

## NOTES:

- The specified limits represent the worst case values for the parameter. Since these worst case values normally occur at the supply voltage and temperature extremes, additional noise immunity can be achieved by decreasing the allowable operating condition ranges.
- Conditions for testing shown in the tables are not necessarily worst case. For worst case testing guidelines, refer to DC Testing, Chapter 1, Section 3.
- The specified limits shown in the DC electrical characteristics table can be met only after thermal equilibrium has been established. Thermal equilibrium is established by applying power for at least 2 minutes, while maintaining transverse airflow of 2.5 meters/sec (500 linear feet/min) over the device, mounted either in a test socket or on a printed circuit board. Test voltage values are given in the DC operating conditions table.
- The device can function down to  $V_{EE} = -5.7V$ , allowing operation with either the 10K or the 10KH family. Correction factors can be used to calculate new DC limits for the extended  $V_{EE}$  range. For more information, see Chapters 5 and 10, Section 4.

## Shift Matrix

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## AC ELECTRICAL CHARACTERISTICS

Ceramic DIP  $V_{CC1} = V_{CC2} = \text{ground}$ ,  $V_{EE} = -4.8\text{V}$  to  $-4.2\text{V}$ 

Ceramic DIP  $V_{CC1} = V_{CC2} = \text{ground}$ ,  $V_{EE} = -4.6\text{V}$  to  $-4.2\text{V}$

| SYMBOL                 | PARAMETER                           | TEST CONDITION | LIMITS                  |              |                           |              |                           |              | UNIT     |
|------------------------|-------------------------------------|----------------|-------------------------|--------------|---------------------------|--------------|---------------------------|--------------|----------|
|                        |                                     |                | $T_A = 0^\circ\text{C}$ |              | $T_A = +25^\circ\text{C}$ |              | $T_A = +85^\circ\text{C}$ |              |          |
|                        |                                     |                | MIN.                    | MAX.         | MIN.                      | MAX.         | MIN.                      | MAX.         |          |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>$D_n$ to $Q_n$ | Waveform 1     | 1.10<br>1.10            | 3.00<br>3.00 | 1.10<br>1.10              | 2.90<br>2.90 | 1.10<br>1.10              | 3.10<br>3.10 | ns<br>ns |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>$M$ to $Q_n$   |                | 1.15<br>1.15            | 4.40<br>4.40 | 1.25<br>1.25              | 4.40<br>4.40 | 1.15<br>1.15              | 4.70<br>4.70 | ns<br>ns |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>$S_n$ to $Q_n$ |                | 1.70<br>1.70            | 4.50<br>4.50 | 1.70<br>1.70              | 4.50<br>4.50 | 1.70<br>1.70              | 4.80<br>4.80 | ns<br>ns |
| $t_{TLH}$<br>$t_{THL}$ | Transition time $Q_n$               |                | 0.50<br>0.50            | 2.20<br>2.20 | 0.50<br>0.50              | 2.20<br>2.20 | 0.50<br>0.50              | 2.20<br>2.20 | ns<br>ns |

## NOTE:

For AC test setup information, see AC Testing, Chapter 2, Section 3.

## AC ELECTRICAL CHARACTERISTICS

Ceramic DIP  $V_{CC1} = V_{CC2} = \text{ground}$ ,  $V_{EE} = -5.2\text{V} \pm 5\%$ 

| Ceramic DIP $V_{CC1} = V_{CC2} = \text{ground}, V_{EE} = -5.2V \pm 5\%$ |                                     |                |                           |              |                             |              |                             |              |          |
|-------------------------------------------------------------------------|-------------------------------------|----------------|---------------------------|--------------|-----------------------------|--------------|-----------------------------|--------------|----------|
| SYMBOL                                                                  | PARAMETER                           | TEST CONDITION | LIMITS                    |              |                             |              |                             |              | UNIT     |
|                                                                         |                                     |                | $T_A = 0^{\circ}\text{C}$ |              | $T_A = +25^{\circ}\text{C}$ |              | $T_A = +85^{\circ}\text{C}$ |              |          |
|                                                                         |                                     |                | MIN.                      | MAX.         | MIN.                        | MAX.         | MIN.                        | MAX.         |          |
| $t_{PLH}$<br>$t_{PHL}$                                                  | Propagation delay<br>$D_n$ to $Q_n$ | Waveform 1     | 1.10<br>1.10              | 3.00<br>3.00 | 1.10<br>1.10                | 2.90<br>2.90 | 1.10<br>1.10                | 3.10<br>3.10 | ns<br>ns |
| $t_{PLH}$<br>$t_{PHL}$                                                  | Propagation delay<br>$M$ to $Q_n$   |                | 1.15<br>1.15              | 4.40<br>4.40 | 1.25<br>1.25                | 4.40<br>4.40 | 1.15<br>1.15                | 4.70<br>4.70 | ns<br>ns |
| $t_{PLH}$<br>$t_{PHL}$                                                  | Propagation delay<br>$S_n$ to $Q_n$ |                | 1.70<br>1.70              | 4.50<br>4.50 | 1.70<br>1.70                | 4.50<br>4.50 | 1.70<br>1.70                | 4.80<br>4.80 | ns<br>ns |
| $t_{TLH}$<br>$t_{THL}$                                                  | Transition time $Q_n$               |                | 0.50<br>0.50              | 2.20<br>2.20 | 0.50<br>0.50                | 2.20<br>2.20 | 0.50<br>0.50                | 2.20<br>2.20 | ns<br>ns |

## NOTE:

For AC test setup information, see AC Testing, Chapter 2, Section 3.

## AC ELECTRICAL CHARACTERISTICS

Flat Pack and PLCC  $V_{CC1} = V_{CC2} = \text{ground}$ ,  $V_{EE} = -4.8\text{V}$  to  $-4.2\text{V}$ 

| Flat Pack and PLCC VCC1 = VCC2 = ground, VEE = -4.5V to -4.2V |                                                       |                |                      |              |                        |              |                        |              |          |
|---------------------------------------------------------------|-------------------------------------------------------|----------------|----------------------|--------------|------------------------|--------------|------------------------|--------------|----------|
| SYMBOL                                                        | PARAMETER                                             | TEST CONDITION | LIMITS               |              |                        |              |                        |              | UNIT     |
|                                                               |                                                       |                | T <sub>A</sub> = 0°C |              | T <sub>A</sub> = +25°C |              | T <sub>A</sub> = +85°C |              |          |
|                                                               |                                                       |                | MIN.                 | MAX.         | MIN.                   | MAX.         | MIN.                   | MAX.         |          |
| t <sub>PLH</sub><br>t <sub>PHL</sub>                          | Propagation delay<br>D <sub>n</sub> to Q <sub>n</sub> | Waveform 1     | 1.10<br>1.10         | 2.80<br>2.80 | 1.10<br>1.10           | 2.70<br>2.70 | 1.10<br>1.10           | 2.90<br>2.90 | ns<br>ns |
| t <sub>PLH</sub><br>t <sub>PHL</sub>                          | Propagation delay<br>M to Q <sub>n</sub>              |                | 1.15<br>1.15         | 4.20<br>4.20 | 1.25<br>1.25           | 4.20<br>4.20 | 1.15<br>1.15           | 4.50<br>4.50 | ns<br>ns |
| t <sub>PLH</sub><br>t <sub>PHL</sub>                          | Propagation delay<br>S <sub>n</sub> to Q <sub>n</sub> |                | 1.70<br>1.70         | 4.30<br>4.30 | 1.70<br>1.70           | 4.30<br>4.30 | 1.70<br>1.70           | 4.60<br>4.60 | ns<br>ns |
| t <sub>TLH</sub><br>t <sub>THL</sub>                          | Transition time Q <sub>n</sub>                        |                | 0.50<br>0.50         | 2.20<br>2.20 | 0.50<br>0.50           | 2.20<br>2.20 | 0.50<br>0.50           | 2.20<br>2.20 | ns<br>ns |

## NOTE:

For AC test setup information, see AC Testing, Chapter 2, Section 3.

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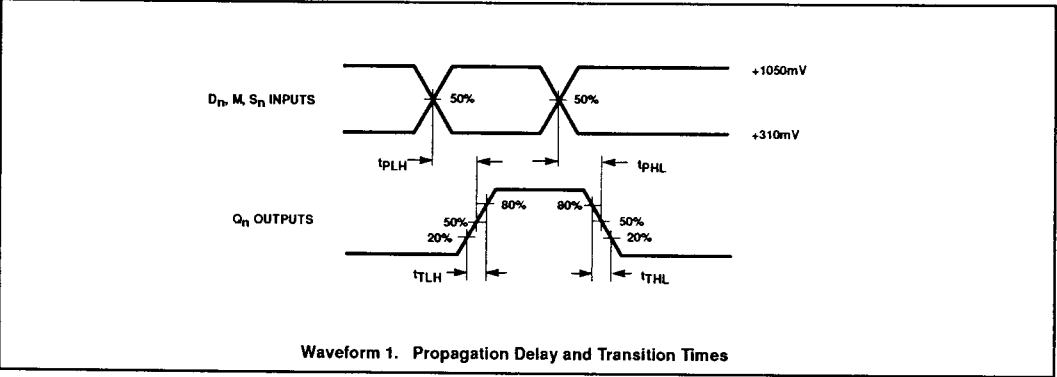
AC ELECTRICAL CHARACTERISTICS

Flat Pack and PLCC  $V_{CC1} = V_{CC2} = \text{ground}$ ,  $V_{EE} = -5.2V \pm 5\%$

| SYMBOL                               | PARAMETER                                             | TEST CONDITION | LIMITS               |              |                        |              |                        |              | UNIT     |
|--------------------------------------|-------------------------------------------------------|----------------|----------------------|--------------|------------------------|--------------|------------------------|--------------|----------|
|                                      |                                                       |                | T <sub>A</sub> = 0°C |              | T <sub>A</sub> = +25°C |              | T <sub>A</sub> = +85°C |              |          |
|                                      |                                                       |                | MIN.                 | MAX.         | MIN.                   | MAX.         | MIN.                   | MAX.         |          |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation delay<br>D <sub>n</sub> to Q <sub>n</sub> | Waveform 1     | 1.10<br>1.10         | 2.80<br>2.80 | 1.10<br>1.10           | 2.70<br>2.70 | 1.10<br>1.10           | 2.90<br>2.90 | ns<br>ns |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation delay<br>M to Q <sub>n</sub>              |                | 1.15<br>1.15         | 4.20<br>4.20 | 1.25<br>1.25           | 4.20<br>4.20 | 1.15<br>1.15           | 4.50<br>4.50 | ns<br>ns |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation delay<br>S <sub>n</sub> to Q <sub>n</sub> |                | 1.70<br>1.70         | 4.30<br>4.30 | 1.70<br>1.70           | 4.30<br>4.30 | 1.70<br>1.70           | 4.60<br>4.60 | ns<br>ns |
| t <sub>TLH</sub><br>t <sub>THL</sub> | Transition time Q <sub>n</sub>                        |                | 0.50<br>0.50         | 2.20<br>2.20 | 0.50<br>0.50           | 2.20<br>2.20 | 0.50<br>0.50           | 2.20<br>2.20 | ns<br>ns |

NOTE:  
For AC test setup information, see AC Testing, Chapter 2, Section 3.

AC WAVEFORMS



NOTE:  
All power and signal voltages shifted up 2.0V for AC bench test purposes.