

December 1992

### Features

- High-Voltage Type (20V Rating)
- Three State Output
- Many Logic Functions Available in One Package
- Standardize, Symmetrical Output Characteristics
- 100% Tested for Quiescent Current at 20V
- Maximum Input Current of 1 $\mu$ A at 18V Over Full Package Temperature Range; 100nA at 18V and +25°C
- Noise Margin (Over Full Package Temperature Range):
  - 1V at VDD = 5V
  - 2V at VDD = 10V
  - 2.5V at VDD = 15V
- 5V, 10V and 15V Parametric Ratings
- Meets All Requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

### Applications

- Selection of Up to 8 Logic Functions
- Digital Control of Logic
- General Purpose Gating Logic
  - Decoding
  - Encoding

### Description

CD4048BMS is an 8-input gate having four control inputs. Three binary control inputs - Ka, Kb, and Kc - provide the implementation of eight different logic functions. These functions are OR, NOR, AND, NAND, OR/AND, OR/NAND, AND/OR and AND/NOR.

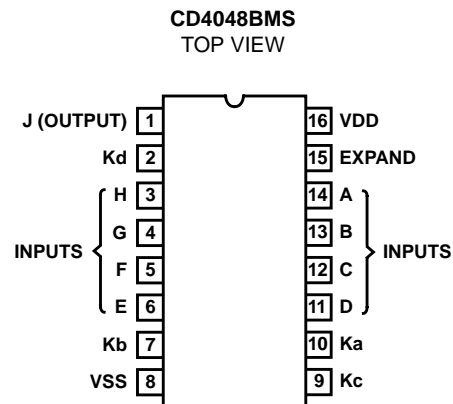
A fourth control input, Kd, provides the user with a 3-state output. When control input Kd is high, the output is either a logic 1 or a logic 0 depending on the inner states. When control input Kd is low, the output is an open circuit. This feature enables the user to connect this device to a common bus line.

In addition to the eight input lines, an EXPAND input is provided that permits the user to increase the number of inputs into a CD4048BMS (see Figure 2). For example, two CD4048BMS's can be cascaded to provided a 16-input multifunction gate. When the EXPAND input is not used, it should be connected to VSS.

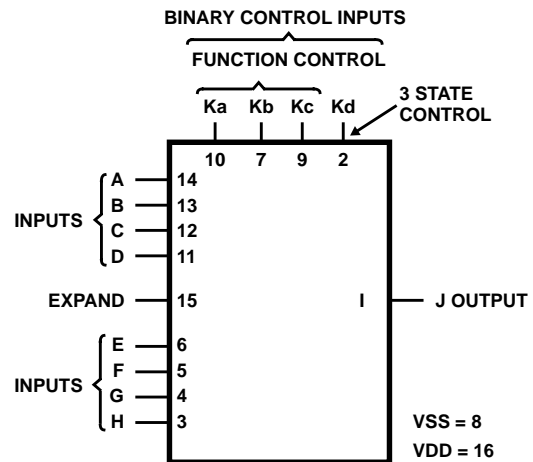
The CD4048BMS is supplied in these 16 lead outline packages:

|                  |     |
|------------------|-----|
| Braze Seal DIP   | H4S |
| Frit Seal DIP    | H1E |
| Ceramic Flatpack | H6W |

### Pinout



### Functional Diagram



# Specifications CD4048BMS

## Absolute Maximum Ratings

|   |   |
|---|---|
| DC Supply Voltage Range, (VDD) . . . . .      | -0.5V to +20V<br>(Voltage Referenced to VSS Terminals)                                |
| Input Voltage Range, All Inputs . . . . .     | -0.5V to VDD +0.5V  |
| DC Input Current, Any One Input . . . . .     | ±10mA   |
| Operating Temperature Range . . . . .         | -55°C to +125°C<br>Package Types D, F, K, H   |
| Storage Temperature Range (TSTG) . . . . .    | -65°C to +150°C   |
| Lead Temperature (During Soldering) . . . . . | +265°C<br>At Distance 1/16 ± 1/32 Inch (1.59mm ± 0.79mm) from case for<br>10s Maximum |

## Reliability Information

|   |   |               |
|---|---|---------------|
| Thermal Resistance . . . . .                                | $\theta_{ja}$                           | $\theta_{jc}$ |
| Ceramic DIP and FRIT Package . . . . .                      | 80°C/W                                  | 20°C/W        |
| Flatpack Package . . . . .                                  | 70°C/W                                  | 20°C/W        |
| Maximum Package Power Dissipation (PD) at +125°C            |   |               |
| For TA = -55°C to +100°C (Package Type D, F, K) . . . . .   | 500mW                                   |               |
| For TA = +100°C to +125°C (Package Type D, F, K) . . . . .  | Derate<br>Linearity at 12mW/°C to 200mW |               |
| Device Dissipation per Output Transistor . . . . .          | 100mW                                   |               |
| For TA = Full Package Temperature Range (All Package Types) |   |               |
| Junction Temperature . . . . .                              | +175°C                                  |               |

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS**

| PARAMETER                   | SYMBOL | CONDITIONS (NOTE 1)                | GROUP A<br>SUBGROUPS | TEMPERATURE          | LIMITS         |                | UNITS |    |
|-----------------------------|--------|------------------------------------|----------------------|----------------------|----------------|----------------|-------|----|
|                             |        |                                    |                      |                      | MIN            | MAX            |       |    |
| Supply Current              | IDD    | VDD = 20V, VIN = VDD or GND        | 1                    | +25°C                | -              | 0.5            | μA    |    |
|                             |        |                                    | 2                    | +125°C               | -              | 50             | μA    |    |
|                             |        | VDD = 18V, VIN = VDD or GND        | 3                    | -55°C                | -              | 0.5            | μA    |    |
| Input Leakage Current       | IIL    | VIN = VDD or GND                   | VDD = 20             | 1                    | +25°C          | -100           | -     | nA |
|                             |        |                                    |                      | 2                    | +125°C         | -1000          | -     | nA |
|                             |        |                                    | VDD = 18V            | 3                    | -55°C          | -100           | -     | nA |
| Input Leakage Current       | IIH    | VIN = VDD or GND                   | VDD = 20             | 1                    | +25°C          | -              | 100   | nA |
|                             |        |                                    |                      | 2                    | +125°C         | -              | 1000  | nA |
|                             |        |                                    | VDD = 18V            | 3                    | -55°C          | -              | 100   | nA |
| Output Voltage              | VOL15  | VDD = 15V, No Load                 | 1, 2, 3              | +25°C, +125°C, -55°C | -              | 50             | mV    |    |
| Output Voltage              | VOH15  | VDD = 15V, No Load (Note 3)        | 1, 2, 3              | +25°C, +125°C, -55°C | 14.95          | -              | V     |    |
| Output Current (Sink)       | IOL5   | VDD = 5V, VOUT = 0.4V              | 1                    | +25°C                | 0.53           | -              | mA    |    |
| Output Current (Sink)       | IOL10  | VDD = 10V, VOUT = 0.5V             | 1                    | +25°C                | 1.4            | -              | mA    |    |
| Output Current (Sink)       | IOL15  | VDD = 15V, VOUT = 1.5V             | 1                    | +25°C                | 3.5            | -              | mA    |    |
| Output Current (Source)     | IOH5A  | VDD = 5V, VOUT = 4.6V              | 1                    | +25°C                | -              | -0.53          | mA    |    |
| Output Current (Source)     | IOH5B  | VDD = 5V, VOUT = 2.5V              | 1                    | +25°C                | -              | -1.8           | mA    |    |
| Output Current (Source)     | IOH10  | VDD = 10V, VOUT = 9.5V             | 1                    | +25°C                | -              | -1.4           | mA    |    |
| Output Current (Source)     | IOH15  | VDD = 15V, VOUT = 13.5V            | 1                    | +25°C                | -              | -3.5           | mA    |    |
| N Threshold Voltage         | VNTH   | VDD = 10V, ISS = -10μA             | 1                    | +25°C                | -2.8           | -0.7           | V     |    |
| P Threshold Voltage         | VPTH   | VSS = 0V, IDD = 10μA               | 1                    | +25°C                | 0.7            | 2.8            | V     |    |
| Functional                  | F      | VDD = 2.8V, VIN = VDD or GND       | 7                    | +25°C                | VOH ><br>VDD/2 | VOL <<br>VDD/2 | V     |    |
|                             |        | VDD = 20V, VIN = VDD or GND        | 7                    | +25°C                |                |                |       |    |
|                             |        | VDD = 18V, VIN = VDD or GND        | 8A                   | +125°C               |                |                |       |    |
|                             |        | VDD = 3V, VIN = VDD or GND         | 8B                   | -55°C                |                |                |       |    |
| Input Voltage Low (Note 2)  | VIL    | VDD = 5V, VOH > 4.5V, VOL < 0.5V   | 1, 2, 3              | +25°C, +125°C, -55°C | -              | 1.5            | V     |    |
| Input Voltage High (Note 2) | VIH    | VDD = 5V, VOH > 4.5V, VOL < 0.5V   | 1, 2, 3              | +25°C, +125°C, -55°C | 3.5            | -              | V     |    |
| Input Voltage Low (Note 2)  | VIL    | VDD = 15V, VOH > 13.5V, VOL < 1.5V | 1, 2, 3              | +25°C, +125°C, -55°C | -              | 4              | V     |    |
| Input Voltage High (Note 2) | VIH    | VDD = 15V, VOH > 13.5V, VOL < 1.5V | 1, 2, 3              | +25°C, +125°C, -55°C | 11             | -              | V     |    |
| Tri-State Output Leakage    | IOZL   | VIN = VDD or GND<br>VOUT = 0V      | VDD = 20V            | 1                    | +25°C          | -0.4           | -     | μA |
|                             |        |                                    |                      | 2                    | +125°C         | -12            | -     | μA |
|                             |        |                                    | VDD = 18V            | 3                    | -55°C          | -0.4           | -     | μA |
| Tri-State Output Leakage    | IOZH   | VIN = VDD or GND<br>VOUT = VDD     | VDD = 20V            | 1                    | +25°C          | -              | 0.4   | μA |
|                             |        |                                    |                      | 2                    | +125°C         | -              | 12    | μA |
|                             |        |                                    | VDD = 18V            | 3                    | -55°C          | -              | 0.4   | μA |

NOTES: 1. All voltages referenced to device GND, 100% testing being implemented. 2. Go/No Go test with limits applied to inputs. 3. For accuracy, voltage is measured differentially to VDD. Limit is 0.050V max.

## Specifications CD4048BMS

**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

| PARAMETER                         | SYMBOL       | CONDITIONS (NOTE 1, 2)     | GROUP A<br>SUBGROUPS | TEMPERATURE   | LIMITS |     | UNITS |
|-----------------------------------|--------------|----------------------------|----------------------|---------------|--------|-----|-------|
|                                   |              |                            |                      |               | MIN    | MAX |       |
| Propagation Delay<br>Ka to Output | TPHL<br>TPLH | VDD = 5V, VIN = VDD or GND | 9                    | +25°C         | -      | 600 | ns    |
|                                   |              |                            | 10, 11               | +125°C, -55°C | -      | 810 | ns    |
| Transition Time                   | TTHL<br>TTLH | VDD = 5V, VIN = VDD or GND | 9                    | +25°C         | -      | 200 | ns    |
|                                   |              |                            | 10, 11               | +125°C, -55°C | -      | 270 | ns    |

**NOTES:**

1. CL = 50pF, RL = 200K, Input TR, TF < 20ns.
2. -55°C and +125°C limits guaranteed, 100% testing being implemented.

**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS**

| PARAMETER                         | SYMBOL         | CONDITIONS                    | NOTES   | TEMPERATURE             | LIMITS |       | UNITS |
|-----------------------------------|----------------|-------------------------------|---------|-------------------------|--------|-------|-------|
|                                   |                |                               |         |                         | MIN    | MAX   |       |
| Supply Current                    | IDD            | VDD = 5V, VIN = VDD or GND    | 1, 2    | -55°C, +25°C            | -      | 0.25  | μA    |
|                                   |                |                               |         | +125°C                  | -      | 7.5   | μA    |
|                                   |                | VDD = 10V, VIN = VDD or GND   | 1, 2    | -55°C, +25°C            | -      | 0.5   | μA    |
|                                   |                |                               |         | +125°C                  | -      | 15    | μA    |
|                                   |                | VDD = 15V, VIN = VDD or GND   | 1, 2    | -55°C, +25°C            | -      | 0.5   | μA    |
|                                   |                |                               |         | +125°C                  | -      | 30    | μA    |
| Output Voltage                    | VOL            | VDD = 5V, No Load             | 1, 2    | +25°C, +125°C,<br>-55°C | -      | 50    | mV    |
| Output Voltage                    | VOL            | VDD = 10V, No Load            | 1, 2    | +25°C, +125°C,<br>-55°C | -      | 50    | mV    |
| Output Voltage                    | VOH            | VDD = 5V, No Load             | 1, 2    | +25°C, +125°C,<br>-55°C | 4.95   | -     | V     |
| Output Voltage                    | VOH            | VDD = 10V, No Load            | 1, 2    | +25°C, +125°C,<br>-55°C | 9.95   | -     | V     |
| Output Current (Sink)             | IOL5           | VDD = 5V, VOUT = 0.4V         | 1, 2    | +125°C                  | 0.36   | -     | mA    |
|                                   |                |                               |         | -55°C                   | 0.64   | -     | mA    |
| Output Current (Sink)             | IOL10          | VDD = 10V, VOUT = 0.5V        | 1, 2    | +125°C                  | 0.9    | -     | mA    |
|                                   |                |                               |         | -55°C                   | 1.6    | -     | mA    |
| Output Current (Sink)             | IOL15          | VDD = 15V, VOUT = 1.5V        | 1, 2    | +125°C                  | 2.4    | -     | mA    |
|                                   |                |                               |         | -55°C                   | 4.2    | -     | mA    |
| Output Current (Source)           | IOH5A          | VDD = 5V, VOUT = 4.6V         | 1, 2    | +125°C                  | -      | -0.36 | mA    |
|                                   |                |                               |         | -55°C                   | -      | -0.64 | mA    |
| Output Current (Source)           | IOH5B          | VDD = 5V, VOUT = 2.5V         | 1, 2    | +125°C                  | -      | -1.15 | mA    |
|                                   |                |                               |         | -55°C                   | -      | -2.0  | mA    |
| Output Current (Source)           | IOH10          | VDD = 10V, VOUT = 9.5V        | 1, 2    | +125°C                  | -      | -0.9  | mA    |
|                                   |                |                               |         | -55°C                   | -      | -1.6  | mA    |
| Output Current (Source)           | IOH15          | VDD = 15V, VOUT = 13.5V       | 1, 2    | +125°C                  | -      | -2.4  | mA    |
|                                   |                |                               |         | -55°C                   | -      | -4.2  | mA    |
| Input Voltage Low                 | VIL            | VDD = 10V, VOH > 9V, VOL < 1V | 1, 2    | +25°C, +125°C,<br>-55°C | -      | 3     | V     |
| Input Voltage High                | VIH            | VDD = 10V, VOH > 9V, VOL < 1V | 1, 2    | +25°C, +125°C,<br>-55°C | 7      | -     | V     |
| Propagation Delay<br>Ka to Output | TPHL1<br>TPLH1 | VDD = 10V                     | 1, 2, 3 | +25°C                   | -      | 300   | ns    |
|                                   |                | VDD = 15V                     | 1, 2, 3 | +25°C                   | -      | 240   | ns    |

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**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)**

| PARAMETER                                    | SYMBOL               | CONDITIONS | NOTES   | TEMPERATURE | LIMITS |     | UNITS |
|--|----------------------|------------|---------|-------------|--------|-----|-------|
|  |                      |            |         |             | MIN    | MAX |       |
| Propagation Delay<br>Inputs to Output        | TPHL2<br>TPLH2       | VDD = 5V   | 1, 2, 3 | +25°C       | -      | 600 | ns    |
|  |                      | VDD = 10V  | 1, 2, 3 | +25°C       | -      | 300 | ns    |
|  |                      | VDD = 15V  | 1, 2, 3 | +25°C       | -      | 240 | ns    |
| Propagation Delay<br>Kb to Output            | TPHL3<br>TPLH3       | VDD = 5V   | 1, 2, 3 | +25°C       | -      | 450 | ns    |
|  |                      | VDD = 10V  | 1, 2, 3 | +25°C       | -      | 170 | ns    |
|  |                      | VDD = 15V  | 1, 2, 3 | +25°C       | -      | 110 | ns    |
| Propagation Delay<br>Kc to Output            | TPHL4<br>TPLH4       | VDD = 5V   | 1, 2, 3 | +25°C       | -      | 280 | ns    |
|  |                      | VDD = 10V  | 1, 2, 3 | +25°C       | -      | 100 | ns    |
|  |                      | VDD = 15V  | 1, 2, 3 | +25°C       | -      | 80  | ns    |
| Propagation Delay<br>Expand Input to Output  | TPHL5<br>TPLH5       | VDD = 5V   | 1, 2, 3 | +25°C       | -      | 380 | ns    |
|  |                      | VDD = 10V  | 1, 2, 3 | +25°C       | -      | 180 | ns    |
|  |                      | VDD = 15V  | 1, 2, 3 | +25°C       | -      | 130 | ns    |
| Propagation Delay<br>3 State<br>Kd to Output | TPHZ, LZ<br>TPZH, ZL | VDD = 5V   | 1, 2, 4 | +25°C       | -      | 160 | ns    |
|  |                      | VDD = 10V  | 1, 2, 4 | +25°C       | -      | 70  | ns    |
|  |                      | VDD = 15V  | 1, 2, 4 | +25°C       | -      | 50  | ns    |
| Transition Time                              | TTLH<br>TTHL         | VDD = 10V  | 1, 2, 3 | +25°C       | -      | 100 | ns    |
|  |                      | VDD = 15V  | 1, 2, 3 | +25°C       | -      | 80  | ns    |
| Input Capacitance                            | CIN                  | Any Input  | 1, 2    | +25°C       | -      | 7   | pF    |
| 3 State Output<br>Capacitance                | CO                   |            | 1, 2    | +25°C       | -      | 10  | pF    |

**NOTES:**

1. All voltages referenced to device GND.
2. The parameters listed on Table 3 are controlled via design or process and are not directly tested. These parameters are characterized on initial design release and upon design changes which would affect these characteristics.
3. CL = 50pF, RL = 200K, Input TR, TF < 20ns.
4. CL = 50pF, RL = 1K, Input TR, TF < 20ns.

**TABLE 4. POST IRRADIATION ELECTRICAL PERFORMANCE CHARACTERISTICS**

| PARAMETER                    | SYMBOL       | CONDITIONS                  | NOTES      | TEMPERATURE | LIMITS         |                          | UNITS |
|------------------------------|--------------|-----------------------------|------------|-------------|----------------|--------------------------|-------|
|                              |              |                             |            |             | MIN            | MAX                      |       |
| Supply Current               | IDD          | VDD = 20V, VIN = VDD or GND | 1, 4       | +25°C       | -              | 25                       | μA    |
| N Threshold Voltage          | VNTH         | VDD = 10V, ISS = -10μA      | 1, 4       | +25°C       | -2.8           | -0.2                     | V     |
| N Threshold Voltage<br>Delta | ΔVTN         | VDD = 10V, ISS = -10μA      | 1, 4       | +25°C       | -              | ±1                       | V     |
| P Threshold Voltage          | VTP          | VSS = 0V, IDD = 10μA        | 1, 4       | +25°C       | 0.2            | 2.8                      | V     |
| P Threshold Voltage<br>Delta | ΔVTP         | VSS = 0V, IDD = 10μA        | 1, 4       | +25°C       | -              | ±1                       | V     |
| Functional                   | F            | VDD = 18V, VIN = VDD or GND | 1          | +25°C       | VOH ><br>VDD/2 | VOL <<br>VDD/2           | V     |
|                              |              | VDD = 3V, VIN = VDD or GND  |            |             |                |                          |       |
| Propagation Delay Time       | TPHL<br>TPLH | VDD = 5V                    | 1, 2, 3, 4 | +25°C       | -              | 1.35 x<br>+25°C<br>Limit | ns    |

- NOTES: 1. All voltages referenced to device GND. 2. CL = 50pF, RL = 200K, Input TR, TF < 20ns. 3. See Table 2 for +25°C limit. 4. Read and Record

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**TABLE 5. BURN-IN AND LIFE TEST DELTA PARAMETERS +25°C**

| PARAMETER               | SYMBOL | DELTA LIMIT              |
|-------------------------|--------|--------------------------|
| Supply Current - SSI    | IDD    | ±0.1μA                   |
| Output Current (Sink)   | IOL5   | ± 20% x Pre-Test Reading |
| Output Current (Source) | IOH5A  | ± 20% x Pre-Test Reading |

**TABLE 6. APPLICABLE SUBGROUPS**

| CONFORMANCE GROUP             | MIL-STD-883 METHOD | GROUP A SUBGROUPS             | READ AND RECORD                       |
|-------------------------------|--------------------|-------------------------------|---------------------------------------|
| Initial Test (Pre Burn-In)    | 100% 5004          | 1, 7, 9                       | IDD, IOL5, IOH5A, RONDEL10            |
| Interim Test 1 (Post Burn-In) | 100% 5004          | 1, 7, 9                       | IDD, IOL5, IOH5A, RONDEL10            |
| Interim Test 2 (Post Burn-In) | 100% 5004          | 1, 7, 9                       | IDD, IOL5, IOH5A, RONDEL10            |
| PDA (Note 1)                  | 100% 5004          | 1, 7, 9, Deltas               |                                       |
| Interim Test 3 (Post Burn-In) | 100% 5004          | 1, 7, 9                       | IDD, IOL5, IOH5A, RONDEL10            |
| PDA (Note 1)                  | 100% 5004          | 1, 7, 9, Deltas               |                                       |
| Final Test                    | 100% 5004          | 2, 3, 8A, 8B, 10, 11          |                                       |
| Group A                       | Sample 5005        | 1, 2, 3, 7, 8A, 8B, 9, 10, 11 |                                       |
| Group B                       | Subgroup B-5       | Sample 5005                   | 1, 2, 3, 7, 8A, 8B, 9, 10, 11, Deltas |
|                               | Subgroup B-6       | Sample 5005                   | 1, 7, 9                               |
| Group D                       | Sample 5005        | 1, 2, 3, 8A, 8B, 9            | Subgroups 1, 2 3                      |

NOTE: 1. 5% Parametric, 3% Functional; Cumulative for Static 1 and 2.

**TABLE 7. TOTAL DOSE IRRADIATION**

| CONFORMANCE GROUPS | MIL-STD-883 METHOD | TEST      |            | READ AND RECORD |            |
|--------------------|--------------------|-----------|------------|-----------------|------------|
|                    |                    | PRE-IRRAD | POST-IRRAD | PRE-IRRAD       | POST-IRRAD |
| Group E Subgroup 2 | 5005               | 1, 7, 9   | Table 4    | 1, 9            | Table 4    |

**TABLE 8. BURN-IN AND IRRADIATION TEST CONNECTIONS**

| FUNCTION                   | OPEN | GROUND | VDD           | 9V ± -0.5V | OSCILLATOR |       |
|----------------------------|------|--------|---------------|------------|------------|-------|
|                            |      |        |               |            | 50kHz      | 25kHz |
| Static Burn-In 1<br>Note 1 | 1    | 2 - 15 | 16            |            |            |       |
| Static Burn-In 2<br>Note 1 | 1    | 8      | 2 - 7, 9 - 16 |            |            |       |
| Dynamic Burn-In<br>Note 1  | -    | 8, 15  | 2, 16         | 1          | 9 - 14     | 3 - 7 |
| Irradiation<br>Note 2      | 1    | 8      | 2 - 7, 9 - 16 |            |            |       |

NOTE:

1. Each pin except VDD and GND will have a series resistor of 10K ± 5%, VDD = 18V ± 0.5V
2. Each pin except VDD and GND will have a series resistor of 47K ± 5%; Group E, Subgroup 2, sample size is 4 dice/wafer, 0 failures, VDD = 10V ± 0.5V

Logic Diagrams

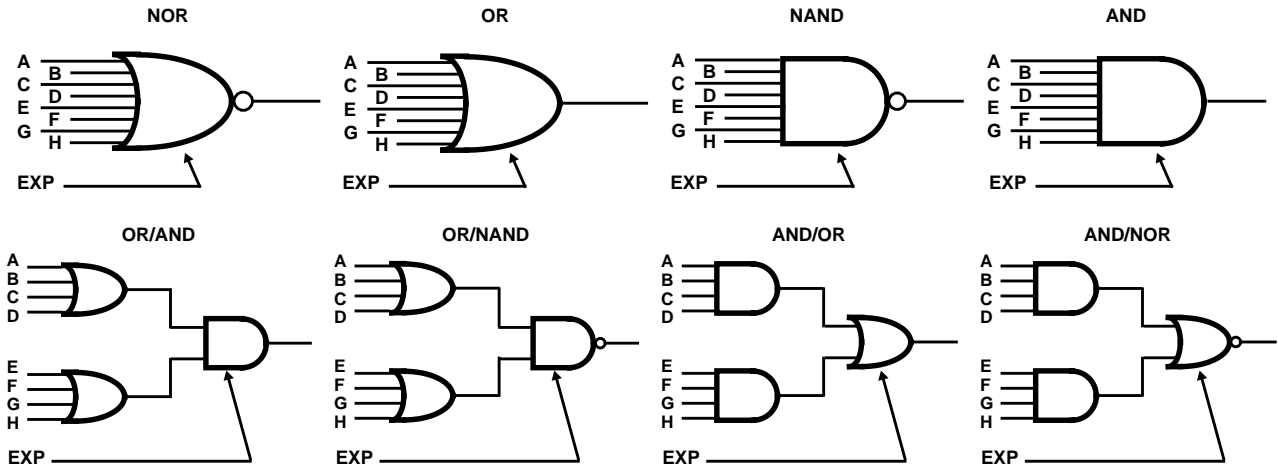


FIGURE 1. BASIC LOGIC CONFIGURATIONS

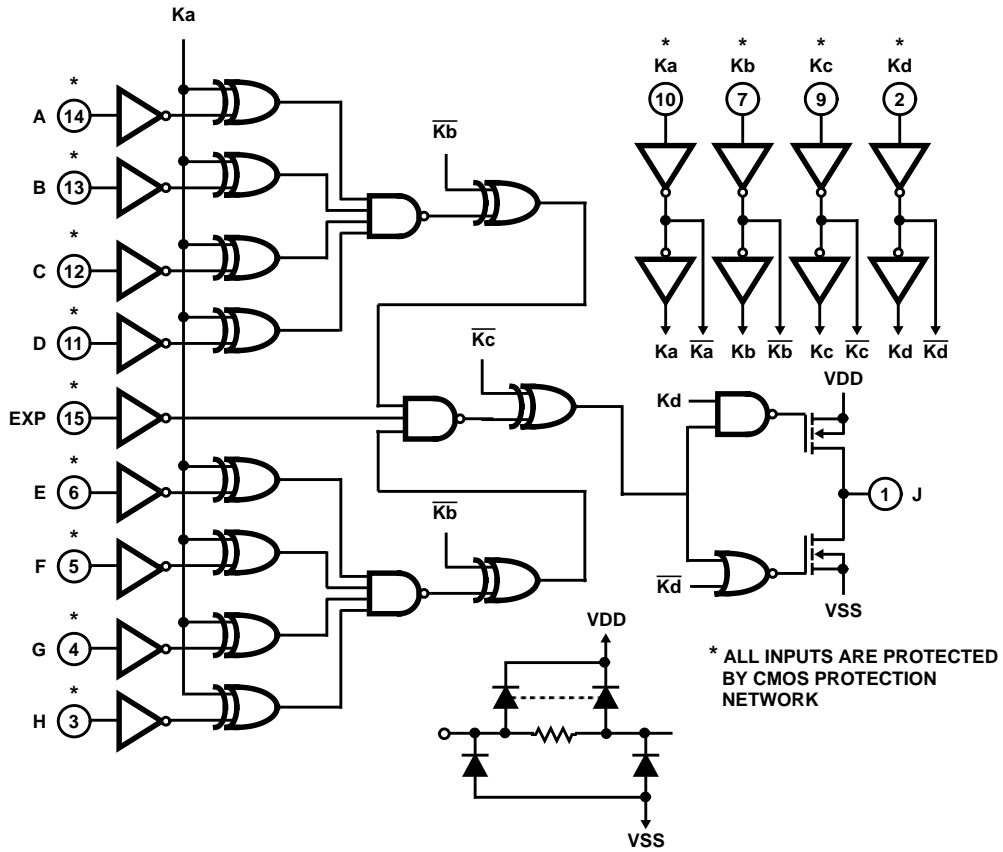


FIGURE 2. LOGIC DIAGRAM

Logic Diagrams (Continued)

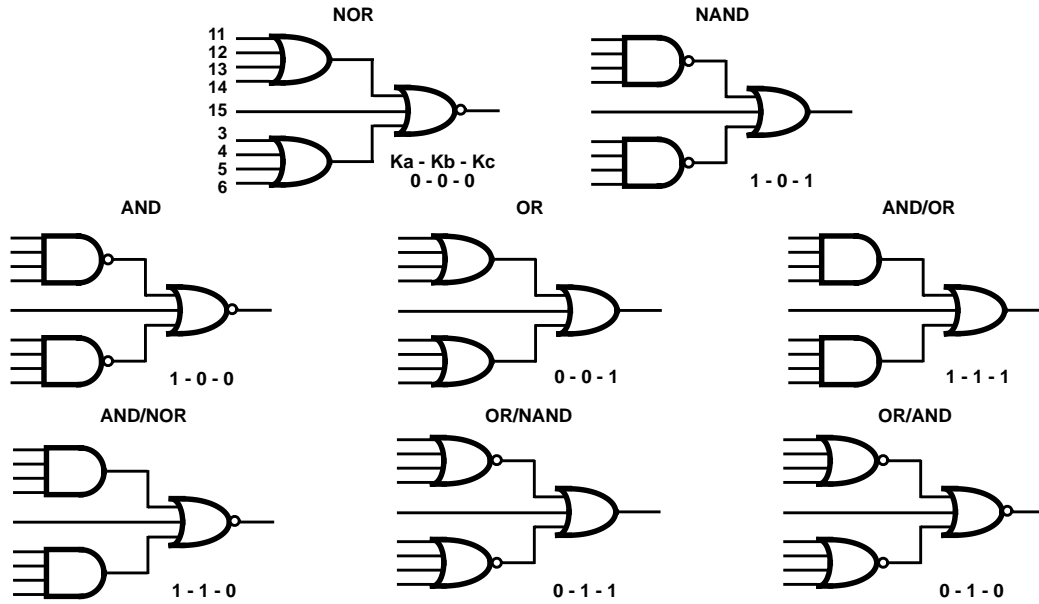
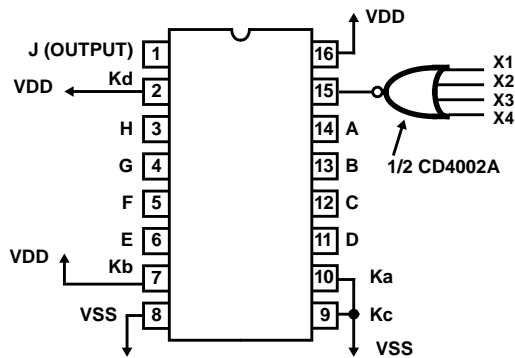


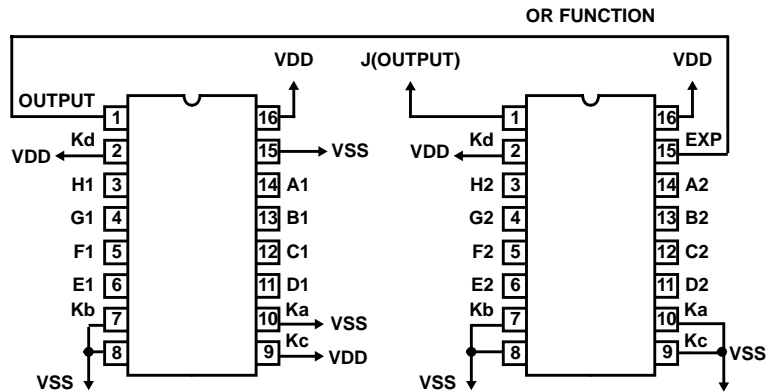
FIGURE 3. ACTUAL CIRCUIT LOGIC CONFIGURATIONS

Applications of Expand Input



12 - INPUT OR/AND GATE  
 $J = (A+B+C+D) \cdot (E+F+G+H) \cdot (X1+X2+X3+X4)$

FIGURE 4. 12 INPUT OR/AND GATE



16 - INPUT NOR GATE  
 $J = A1 + B1 + C1 + D1 + E1 + F1 + G1 + H1 + A2 + B2 + C2 + D2 + E2 + F2 + G2 + H2$

FIGURE 5. 16 INPUT NOR GATE

IMPLEMENTATION OF EXPAND INPUT FOR 9 OR MORE INPUTS

| OUTPUT FUNCTION | FUNCTION NEEDED AT EXPAND INPUT | OUTPUT BOOLEAN EXPRESSION  |
|-----------------|---------------------------------|--|
| NOR             | OR                              | $J = \overline{(A+B+C+D+E+F+G+H)} + (\text{EXP})$                        |
| OR              | OR                              | $J = (A+B+C+D+E+F+G+H) + (\text{EXP})$                                   |
| AND             | NAND                            | $J = \overline{(ABCDEF GH)} \cdot (\text{EXP})$                          |
| NAND            | NAND                            | $J = \overline{(ABCDEF GH)} \cdot (\text{EXP})$                          |
| OR/AND          | NOR                             | $J = (A+B+C+D) \cdot (E+F+G+H) \cdot \overline{(\text{EXP})}$            |
| OR/NAND         | NOR                             | $J = \overline{(A+B+C+D)} \cdot (E+F+G+H) \cdot \overline{(\text{EXP})}$ |
| AND/NOR         | AND                             | $J = \overline{(ABCD)} + (EFGH) + (\text{EXP})$                          |
| AND/OR          | AND                             | $J = (ABCD) + (EFGH) + (\text{EXP})$                                     |

NOTES: 1. (EXP) designates the EXPAND function (i.e.,  $X1 + X2 + \dots + XN$ ).

2. Refer to FUNCTION TRUTH TABLE for connection of unused inputs.

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FUNCTION TRUTH TABLE

| OUTPUT FUNCTION | BOOLEAN EXPRESSION                     | Ka | Kb | Kc | UNUSED INPUT* |
|-----------------|--|----|----|----|---------------|
| NOR             | $J=\overline{A+B+C+D+E+F+G+H}$         | 0  | 0  | 0  | VSS           |
| OR              | $J=A+B+C+D+E+F+G+H$                    | 0  | 0  | 1  | VSS           |
| OR/AND          | $J=(A+B+C+D)\cdot(E+F+G+H)$            | 0  | 1  | 0  | VSS           |
| OR/NAND         | $J=\overline{(A+B+C+D)\cdot(E+F+G+H)}$ | 0  | 1  | 1  | VSS           |
| AND             | $J=ABCDEFGH$                           | 1  | 0  | 0  | VDD           |
| NAND            | $J=\overline{ABCDEFGH}$                | 1  | 0  | 1  | VDD           |
| AND/NOR         | $J=\overline{ABCD+EFGH}$               | 1  | 1  | 0  | VDD           |
| AND/OR          | $J=ABCD+EFGH$                          | 1  | 1  | 1  | VDD           |

Kd = 1 Normal Inverter Action  
Kd = 0 High Impedance Output

EXPAND Input = 0

\*See Figures 1, 2, 3, 4 and 5

## Typical Performance Characteristics

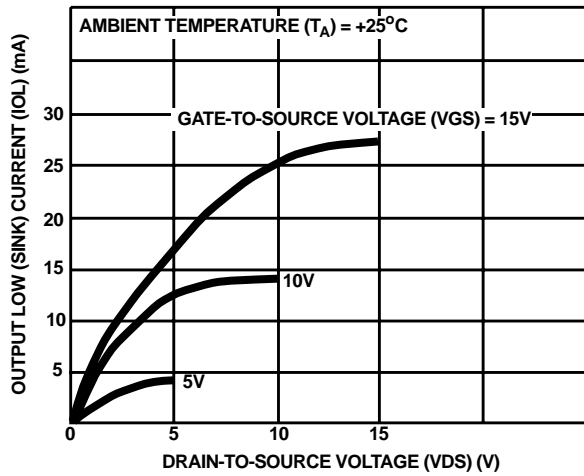


FIGURE 6. TYPICAL OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

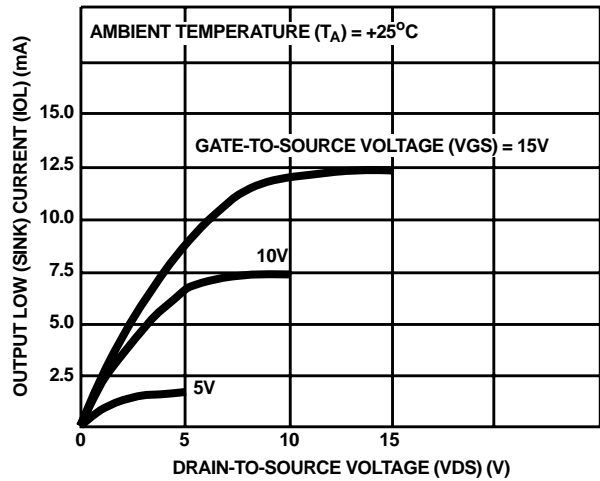


FIGURE 7. MINIMUM OUTPUT LOW (SINK) CURRENT CHARACTERISTICS



Typical Performance Characteristics (Continued)

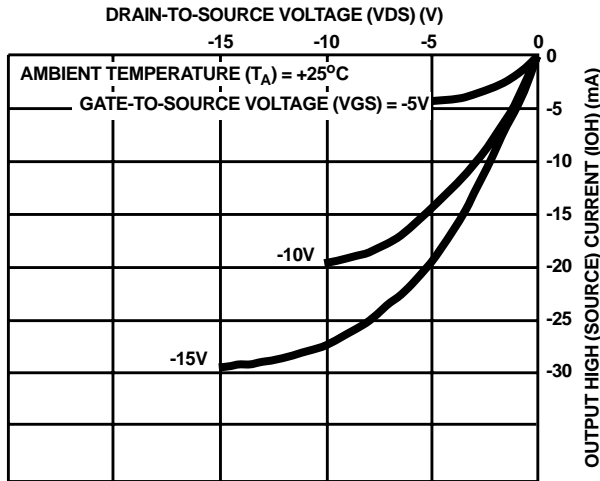


FIGURE 8. TYPICAL OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

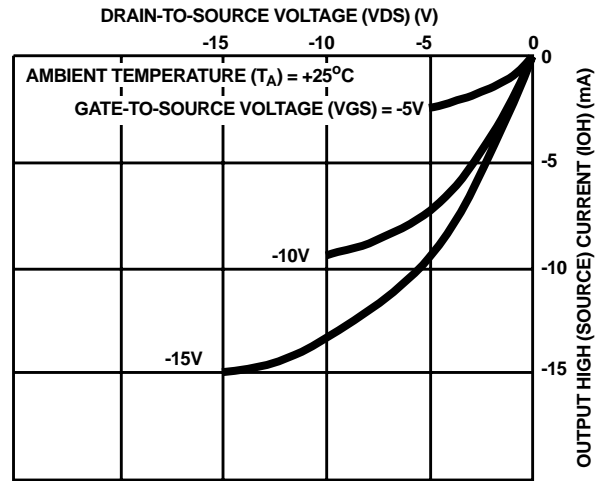


FIGURE 9. MINIMUM OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

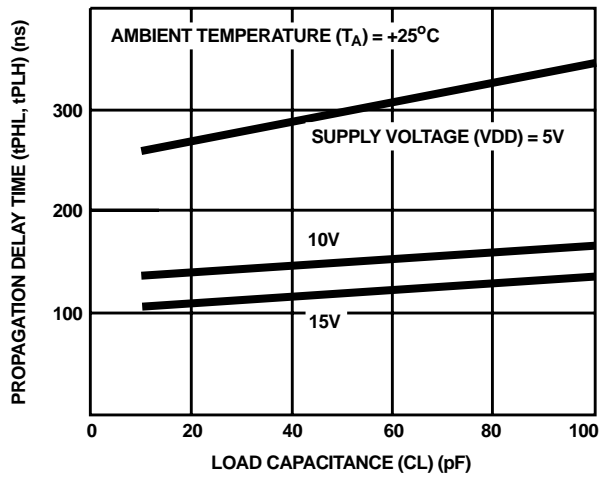


FIGURE 10. TYPICAL PROPAGATION DELAY TIME (LOGIC INPUTS TO OUTPUT) AS A FUNCTION OF LOAD CAPACITANCE

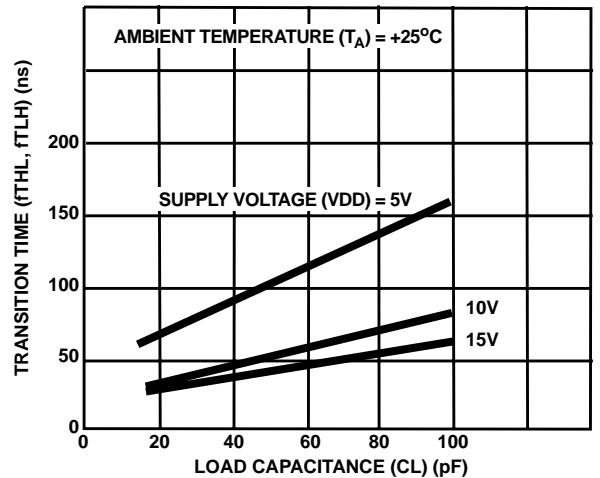


FIGURE 11. TYPICAL TRANSITION TIME vs LOAD CAPACITANCE

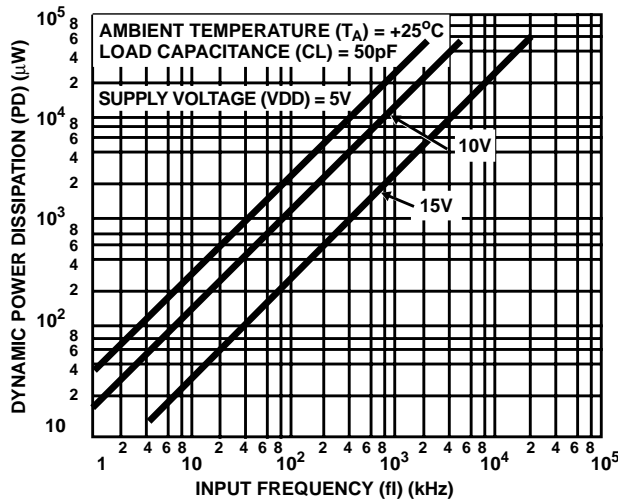


FIGURE 12. TYPICAL POWER DISSIPATION AS A FUNCTION OF INPUT FREQUENCY

Test Circuits and Wave Forms

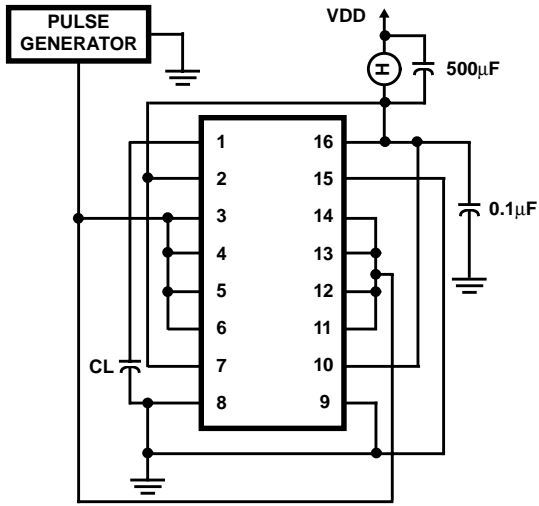


FIGURE 13. DYNAMIC POWER DISSIPATION TEST CIRCUIT

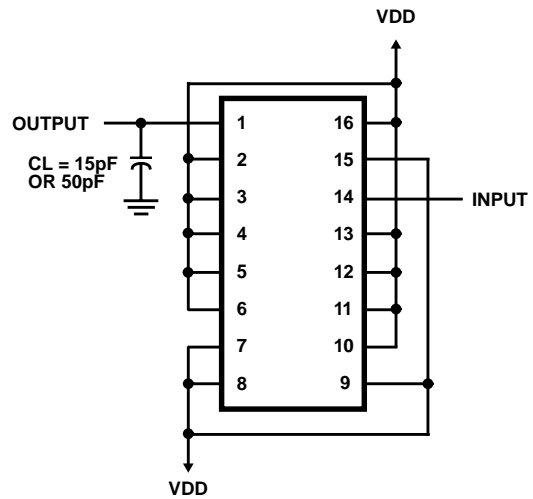


FIGURE 14. TEST CIRCUIT FOR  $t_{PHL}$ ,  $t_{THL}$ , AND  $t_{TLH}$  (AND) MEASUREMENTS

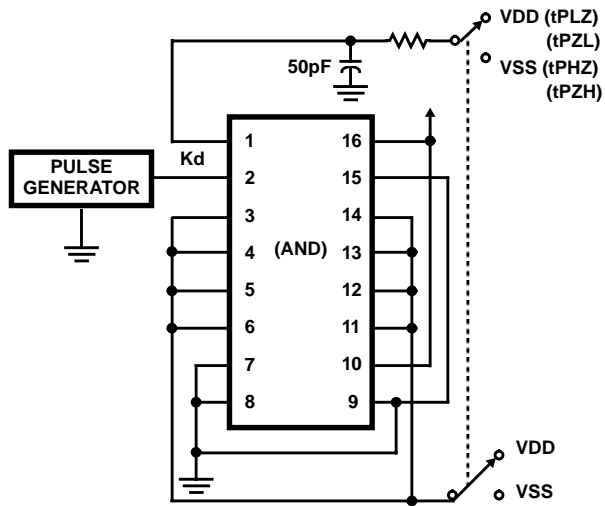


FIGURE 15. TEST CIRCUIT FOR  $t_{PZL}$ ,  $t_{PZH}$ ,  $t_{PLZ}$ , AND  $t_{PHZ}$  (AND)

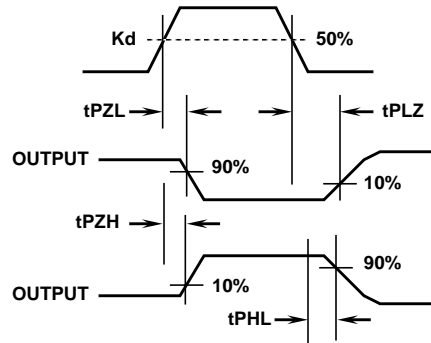


FIGURE 16. WAVEFORMS FOR  $t_{PZL}$ ,  $t_{PZH}$ ,  $t_{PLZ}$  AND  $t_{PHZ}$  (AND)

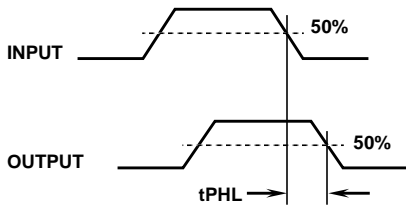


FIGURE 17. WAVEFORMS FOR  $t_{PHL}$  AND  $t_{PLH}$  (AND)

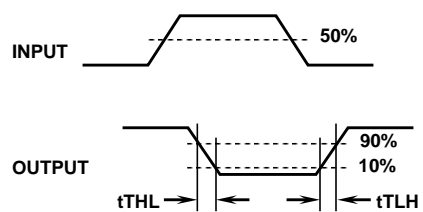
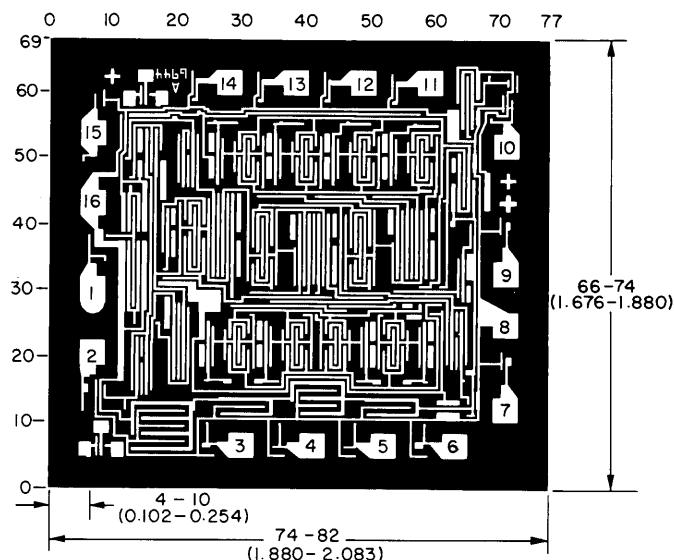


FIGURE 18. WAVEFORMS FOR  $t_{THL}$  AND  $t_{TLH}$  (AND)

# CD4048BMS

## Chip Dimensions and Pad Layout



Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils ( $10^{-3}$  inch)

**METALLIZATION:** Thickness:  $11\text{k}\text{\AA} - 14\text{k}\text{\AA}$ , AL.

**PASSIVATION:**  $10.4\text{k}\text{\AA} - 15.6\text{k}\text{\AA}$ , Silane

**BOND PADS:** 0.004 inches X 0.004 inches MIN

**DIE THICKNESS:** 0.0198 inches - 0.0218 inches

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