

December 1992

## CMOS 8 Input NAND/AND Gate

### Features

- High Voltage Type (20V Rating)
- Medium Speed Operation
  - T<sub>PHL</sub>, T<sub>PLH</sub> = 75ns (Typ.) at V<sub>DD</sub> = 10V
- Buffered Inputs and Outputs
- 5V, 10V and 15V Parametric Ratings
- Standardized Symmetrical Output Characteristics
- 100% Tested for Quiescent Current at 20V
- Maximum Input Current of 1μA at 18V Over Full Package Temperature Range; 100nA at 18V and +25°C
- Noise Margin (Over Full Package/Temperature Range)
  - 1V at V<sub>DD</sub> = 5V
  - 2V at V<sub>DD</sub> = 10V
  - 2.5V at V<sub>DD</sub> = 15V
- Meets All Requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

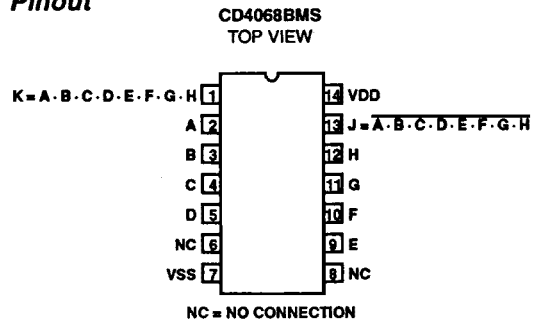
### Description

CD4068BMS NAND/AND gate provides the system designer with direct implementation of the positive logic 8 Input NAND and AND functions and supplements the existing family of CMOS gates.

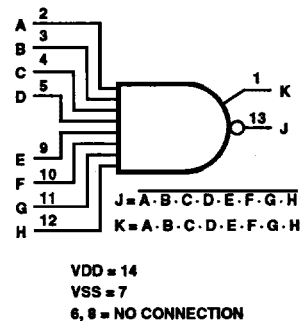
The CD4068BMS is supplied in these 14 lead outline packages:

|                  |     |
|------------------|-----|
| Braze Seal DIP   | H4H |
| Frit Seal DIP    | H1B |
| Ceramic Flatpack | H3W |

### Pinout



### Functional Diagram



### Logic Diagram

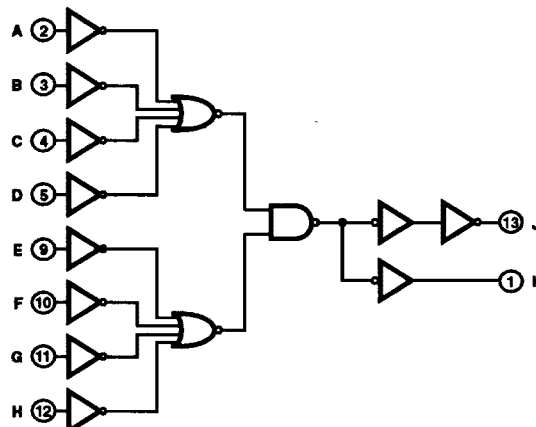


FIGURE 1. LOGIC DIAGRAM

# Specifications CD4068BMS

## Absolute Maximum Ratings

DC Supply Voltage Range, (VDD) ..... -0.5V to +20V  
 (Voltage Referenced to VSS Terminals)  
 Input Voltage Range, All Inputs ..... -0.5V to VDD +0.5V  
 DC Input Current, Any One Input .....  $\pm 10\text{mA}$   
 Operating Temperature Range ..... -55°C to +125°C  
 Package Types D, F, K, H  
 Storage Temperature Range (TSTG) ..... -65°C to +150°C  
 Lead Temperature (During Soldering) ..... +265°C  
 At Distance 1/16  $\pm$  1/32 Inch (1.59mm  $\pm$  0.79mm) from case for  
 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  
 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            | $\mu\text{A}$ |
|                                |        |                                       |           | 2                    | +125°C               | -              | 50             | $\mu\text{A}$ |
|                                |        | VDD = 18V, VIN = VDD or GND           |           | 3                    | -55°C                | -              | 0.5            | $\mu\text{A}$ |
| 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 = -10 $\mu\text{A}$    |           | 1                    | +25°C                | -2.8           | -0.7           | V             |
| P Threshold Voltage            | VPTH   | VSS = 0V, IDD = 10 $\mu\text{A}$      |           | 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<br>(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<br>(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<br>(Note 2)  | VIL    | VDD = 15V, VOH > 13.5V,<br>VOL < 1.5V |           | 1, 2, 3              | +25°C, +125°C, -55°C | -              | 4              | V             |
| Input Voltage High<br>(Note 2) | VIH    | VDD = 15V, VOH > 13.5V,<br>VOL < 1.5V |           | 1, 2, 3              | +25°C, +125°C, -55°C | 11             | -              | V             |

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.

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**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

| PARAMETER         | SYMBOL       | CONDITIONS (NOTES 1, 2)    | GROUP A<br>SUBGROUPS | TEMPERATURE   | LIMITS |     | UNITS |
|-------------------|--------------|----------------------------|----------------------|---------------|--------|-----|-------|
|                   |              |                            |                      |               | MIN    | MAX |       |
| Propagation Delay | TPHL<br>TPLH | VDD = 5V, VIN = VDD or GND | 9                    | +25°C         | -      | 300 | ns    |
|                   |              |                            | 10, 11               | +125°C, -55°C | -      | 405 | 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, -55°C | -      | 50    | mV    |
| Output Voltage          | VOL    | VDD = 10V, No Load          | 1, 2  | +25°C, +125°C, -55°C | -      | 50    | mV    |
| Output Voltage          | VOH    | VDD = 5V, No Load           | 1, 2  | +25°C, +125°C, -55°C | 4.95   | -     | V     |
| Output Voltage          | VOH    | VDD = 10V, No Load          | 1, 2  | +25°C, +125°C, -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                | -      | -2.6  | mA    |
| Output Current (Source) | IOH15  | VDD = 15V, VOUT = 13.5V     | 1, 2  | +125°C               | -      | -2.4  | mA    |
|                         |        |                             |       | -55°C                | -      | -4.2  | mA    |

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

| PARAMETER          | SYMBOL       | CONDITIONS                    | NOTES   | TEMPERATURE          | LIMITS |     | UNITS |
|--------------------|--------------|-------------------------------|---------|----------------------|--------|-----|-------|
|                    |              |                               |         |                      | MIN    | MAX |       |
| Input Voltage Low  | VIL          | VDD = 10V, VOH > 9V, VOL < 1V | 1, 2    | +25°C, +125°C, -55°C | -      | 3   | V     |
| Input Voltage High | VIH          | VDD = 10V, VOH > 9V, VOL < 1V | 1, 2    | +25°C, +125°C, -55°C | 7      | -   | V     |
| Propagation Delay  | TPHL<br>TPLH | VDD = 10V                     | 1, 2, 3 | +25°C                | -      | 150 | ns    |
|                    |              | VDD = 15V                     | 1, 2, 3 | +25°C                | -      | 110 | ns    |
| Transition Time    | 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                | -      | 7.5 | 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.

**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       | -           | 2.5                | μA    |
| N Threshold Voltage       | VNTH         | VDD = 10V, ISS = -10μA      | 1, 4       | +25°C       | -2.8        | -0.2               | V     |
| N Threshold Voltage 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 Delta | ΔVTP         | VSS = 0V, IDD = 10μA        | 1, 4       | +25°C       | -           | ±1                 | V     |
| Functional                | F            | VDD = 18V, VIN = VDD or GND | 1          | +25°C       | VOH > VDD/2 | VOL < 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 +25°C Limit | ns    |

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

**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 |

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**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             |
| Interim Test 1 (Post Burn-In) |              | 100% 5004          | 1, 7, 9                               | IDD, IOL5, IOH5A             |
| Interim Test 2 (Post Burn-In) |              | 100% 5004          | 1, 7, 9                               | IDD, IOL5, IOH5A             |
| PDA (Note 1)                  |              | 100% 5004          | 1, 7, 9, Deltas                       |                              |
| Interim Test 3 (Post Burn-In) |              | 100% 5004          | 1, 7, 9                               | IDD, IOL5, IOH5A             |
| 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 | Subgroups 1, 2, 3, 9, 10, 11 |
|                               | 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, 6, 8, 13 | 2-5, 7, 9-12 | 14            |            |            |       |
| Static Burn-In 2<br>Note 1 | 1, 6, 8, 13 | 7            | 2-5, 9-12, 14 |            |            |       |
| Dynamic Burn-In<br>Note 1  | 6, 8        | 7            | 14            | 1, 13      | 2-5, 9-12  |       |
| Irradiation<br>Note 2      | 1, 6, 8, 13 | 7            | 2-5, 9-12, 14 |            |            |       |

NOTE:

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



## Typical Performance Characteristics

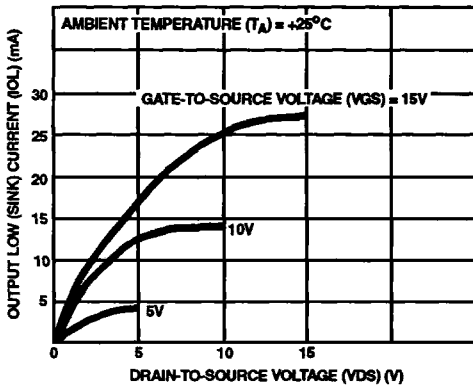


FIGURE 3. TYPICAL OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

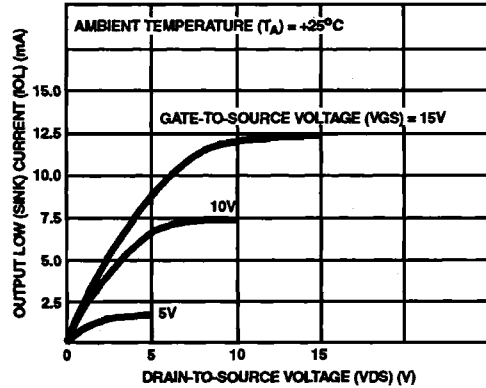


FIGURE 4. MINIMUM OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

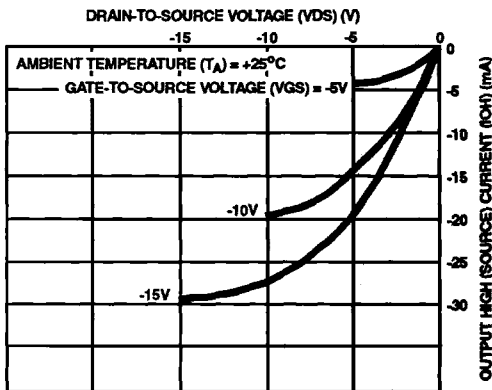


FIGURE 5. TYPICAL OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

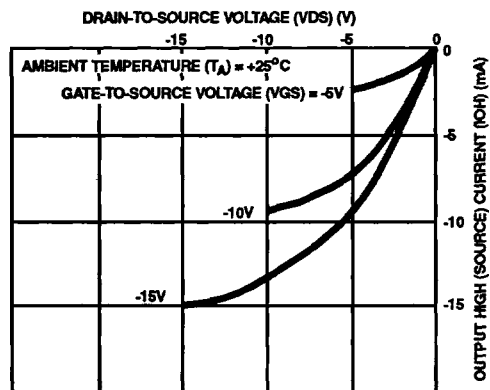


FIGURE 6. MINIMUM OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

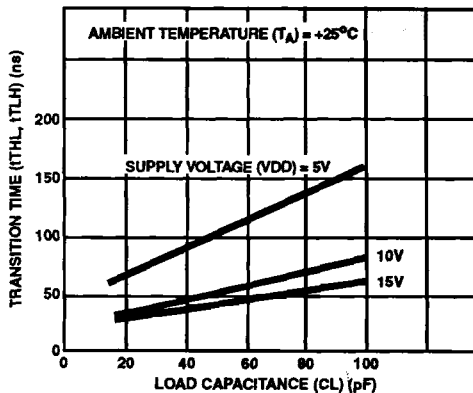


FIGURE 7. TYPICAL TRANSITION TIME AS A FUNCTION OF LOAD CAPACITANCE

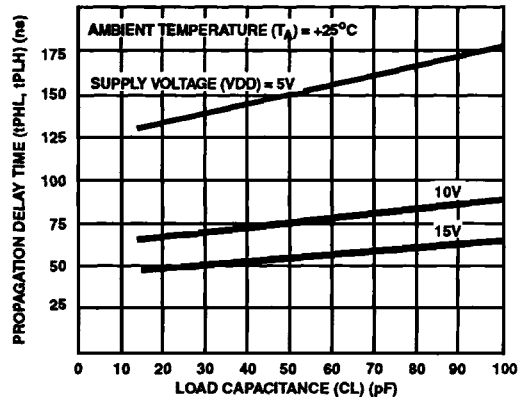


FIGURE 8. TYPICAL PROPAGATION DELAY TIME AS A FUNCTION OF LOAD CAPACITANCE

## Typical Performance Characteristics (Continued)

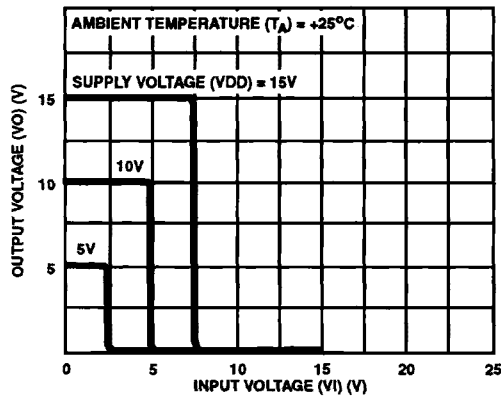


FIGURE 9. TYPICAL VOLTAGE TRANSFER CHARACTERISTICS (NAND OUTPUT)

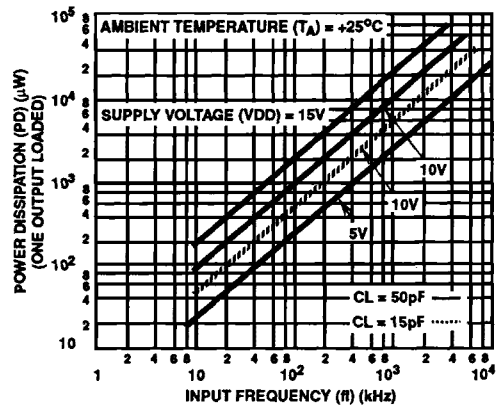
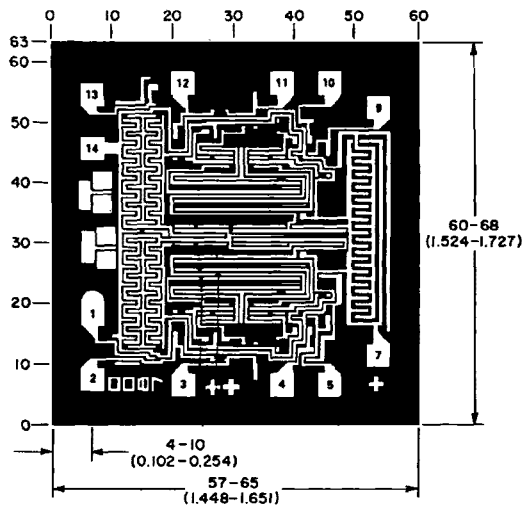


FIGURE 10. TYPICAL DYNAMIC POWER DISSIPATION AS A FUNCTION OF FREQUENCY

## Chip Dimensions and Pad Layout



Dimensions in parenthesis 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