

December 1992

## CMOS Quad Exclusive-OR Gate

### Features

- High Voltage Type (20V Rating)
- Medium-Speed Operation
  - $t_{PHL}$ ,  $t_{PLH}$  = 65ns (typ) at  $V_{DD}$  = 10V,  $C_L$  = 50pF
- 100% Tested for Quiescent Current at 20V
- Standardized Symmetrical Output Characteristics
- 5V, 10V and 15V Parametric Ratings
- 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  $V_{DD}$  = 5V
  - 2V at  $V_{DD}$  = 10V
  - 2.5V at  $V_{DD}$  = 15V
- Meets All Requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

### Applications

- Even and Odd-Parity Generators and Checkers
- Logical Comparators
- Adders/Subtractors
- General Logic Functions

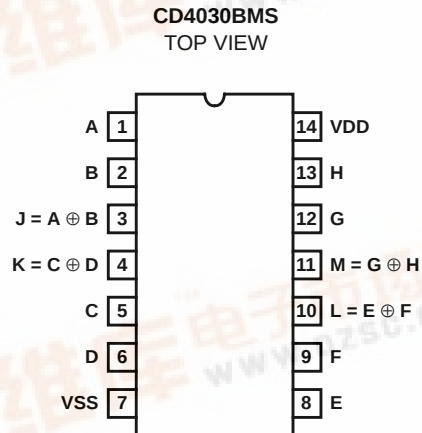
### Description

The CD4030BMS types consist of four independent Exclusive-OR gates. The CD4030BMS provides the system designer with a means for direct implementation of the Exclusive-OR function.

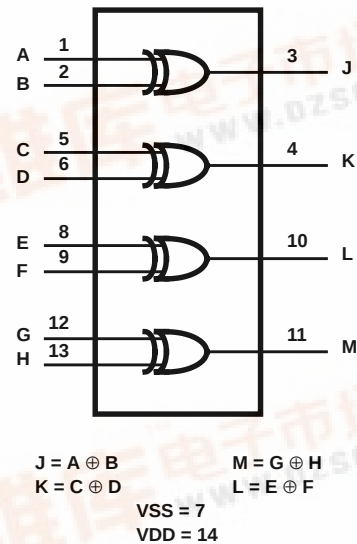
The CD4030BMS is supplied in these 14-lead outline packages:

Braze Seal DIP    H4H  
Frit Seal DIP    H1B  
Ceramic Flatpack H3W

### Pinout



### Functional Diagram



## Specifications CD4030BMS

### 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 . . . . . ±10mA  
 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 ± 1/32 Inch (1.59mm ± 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                | -              | 2              | μA    |
|                                |        |                                       |           | 2                    | +125°C               | -              | 200            | μA    |
|                                |        | VDD = 18V, VIN = VDD or GND           |           | 3                    | -55°C                | -              | 2              | 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<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. 3. For accuracy, voltage is measured differentially to VDD. Limit is 0.050V max.  
 2. Go/No Go test with limits applied to inputs.

## Specifications CD4030BMS

**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

| PARAMETER         | SYMBOL       | CONDITIONS (NOTE 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         | -      | 280 | ns    |
|                   |              |                            | 10, 11               | +125°C, -55°C | -      | 378 | 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            | -      | 1     | μA    |
|                         |              |                               |         | +125°C                  | -      | 30    | μA    |
|                         |              | VDD = 10V, VIN = VDD or GND   | 1, 2    | -55°C, +25°C            | -      | 2     | μA    |
|                         |              |                               |         | +125°C                  | -      | 60    | μA    |
|                         |              | VDD = 15V, VIN = VDD or GND   | 1, 2    | -55°C, +25°C            | -      | 2     | μA    |
|                         |              |                               |         | +125°C                  | -      | 120   | 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       | TPHL<br>TPLH | VDD = 10V                     | 1, 2, 3 | +25°C                   | -      | 130   | ns    |
|                         |              | VDD = 15V                     | 1, 2, 3 | +25°C                   | -      | 100   | ns    |

## Specifications CD4030BMS

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

| PARAMETER         | SYMBOL       | CONDITIONS | NOTES   | TEMPERATURE | LIMITS |     | UNITS |
|-------------------|--------------|------------|---------|-------------|--------|-----|-------|
|                   |              |            |         |             | MIN    | MAX |       |
| Transition Time   | TTHL<br>TTLH | 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       | -           | 7.5                | 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 - MSI-1  | IDD    | ± 0.2μA                  |
| 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 |
| 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 |                  |

## Specifications CD4030BMS

**TABLE 6. APPLICABLE SUBGROUPS (Continued)**

| CONFORMANCE GROUP |              | MIL-STD-883 METHOD | GROUP A SUBGROUPS                     | READ AND RECORD              |
|-------------------|--------------|--------------------|---------------------------------------|------------------------------|
| 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    |

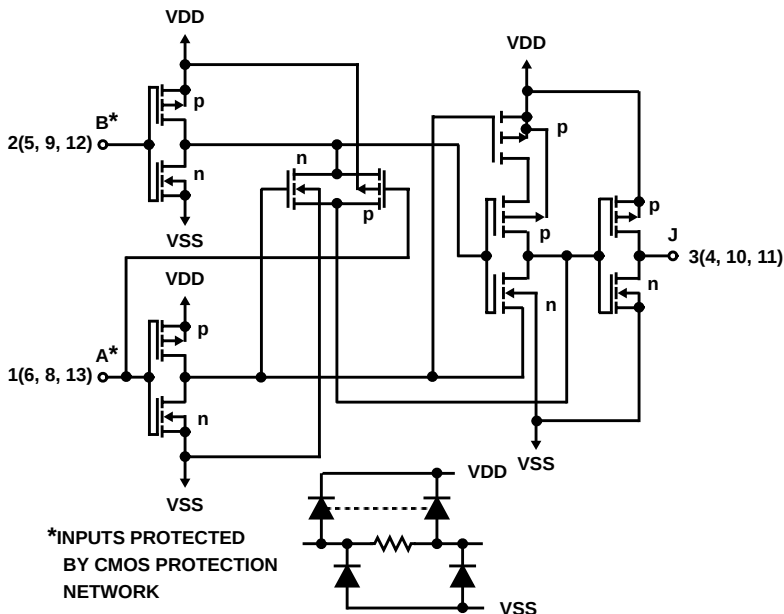
**TABLE 8. BURN-IN AND IRRADIATION TEST CONNECTIONS**

| FUNCTION                   | OPEN         | GROUND              | VDD                          | 9V ± 0.5V    | OSCILLATOR  |             |
|----------------------------|--------------|---------------------|------------------------------|--------------|-------------|-------------|
|                            |              |                     |                              |              | 50kHz       | 25kHz       |
| Static Burn-In 1<br>Note 1 | 3, 4, 10, 11 | 1, 2, 5 - 9, 12, 13 | 14                           |              |             |             |
| Static Burn-In 2<br>Note 1 | 3, 4, 10, 11 | 7                   | 1, 2, 5, 6, 8, 9,<br>12 - 14 |              |             |             |
| Dynamic Burn-In<br>Note 1  | -            | 7                   | 14                           | 3, 4, 10, 11 | 2, 6, 9, 13 | 1, 5, 8, 12 |
| Irradiation<br>Note 2      | 3, 4, 10, 11 | 7                   | 1, 2, 5, 6, 8, 9,<br>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,  $VDD = 10V \pm 0.5V$

### Schematic Diagram



**TRUTH TABLE FOR 1 OF 4 IDENTICAL GATES**

| A | B | J |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 1 | 0 |

1 = High Level

0 = Low Level

**FIGURE 1. 1 OF 4 IDENTICAL GATES**

# CD4030BMS

## Typical Performance Characteristics

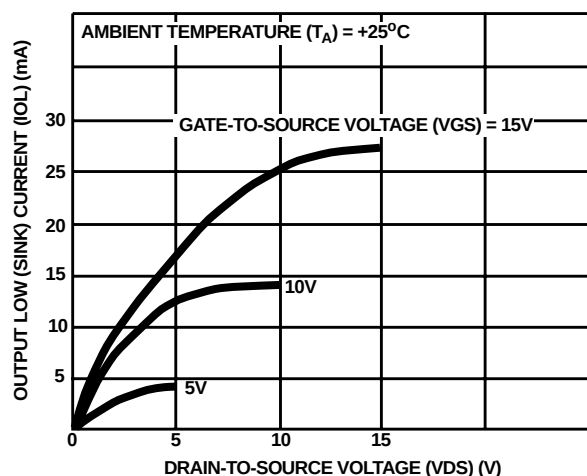


FIGURE 2. TYPICAL OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

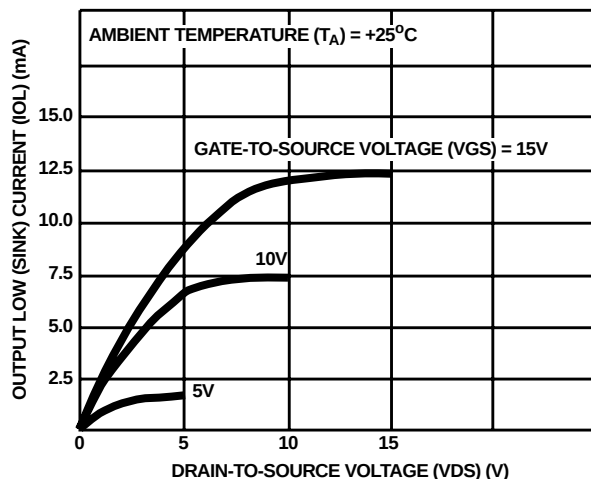


FIGURE 3. MINIMUM OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

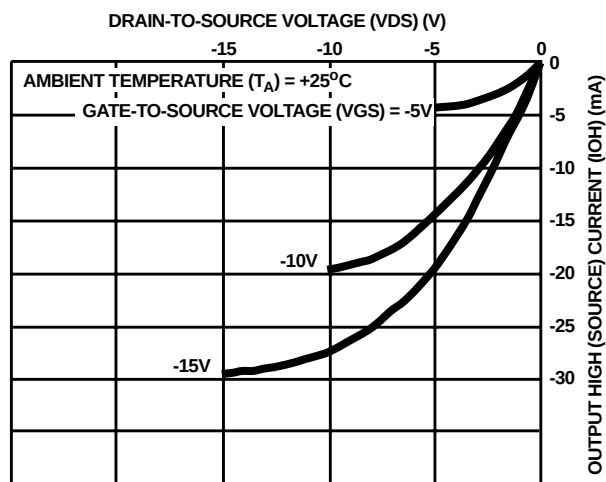


FIGURE 4. TYPICAL OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

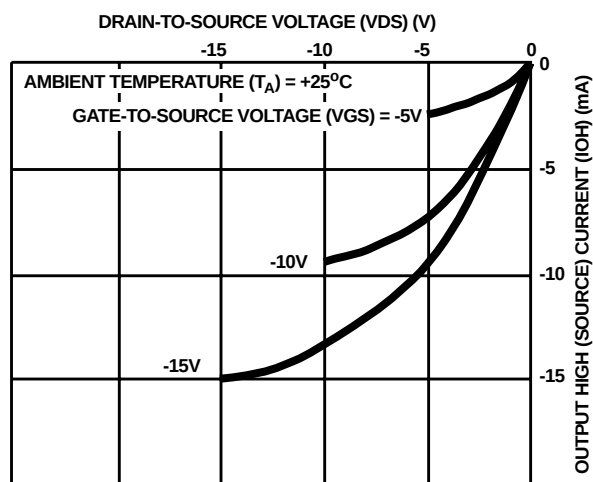


FIGURE 5. MINIMUM OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

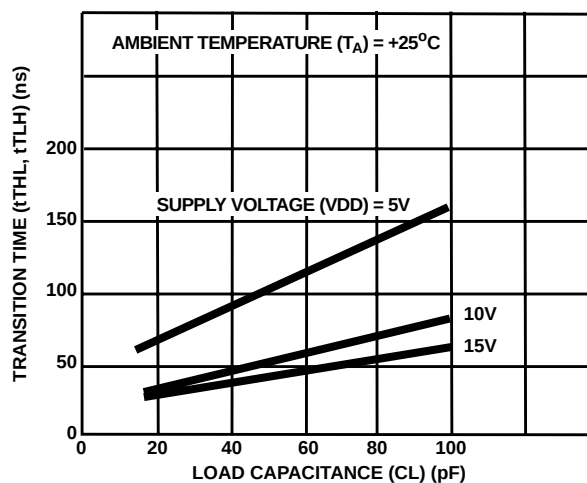


FIGURE 6. TYPICAL TRANSITION TIME AS A FUNCTION OF LOAD CAPACITANCE

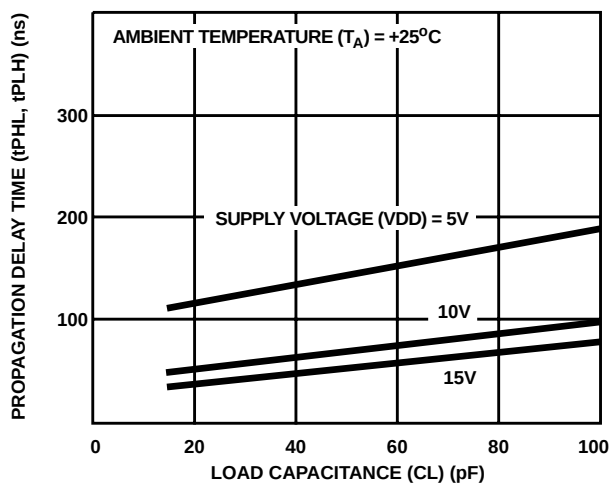


FIGURE 7. TYPICAL PROPAGATION DELAY TIME AS A FUNCTION OF LOAD CAPACITANCE

## CD4030BMS

### Typical Performance Characteristics (Continued)

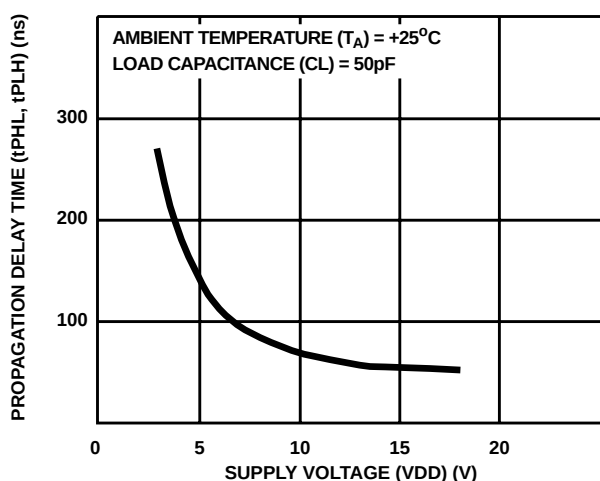


FIGURE 8. TYPICAL PROPAGATION DELAY TIME AS A FUNCTION OF SUPPLY VOLTAGE

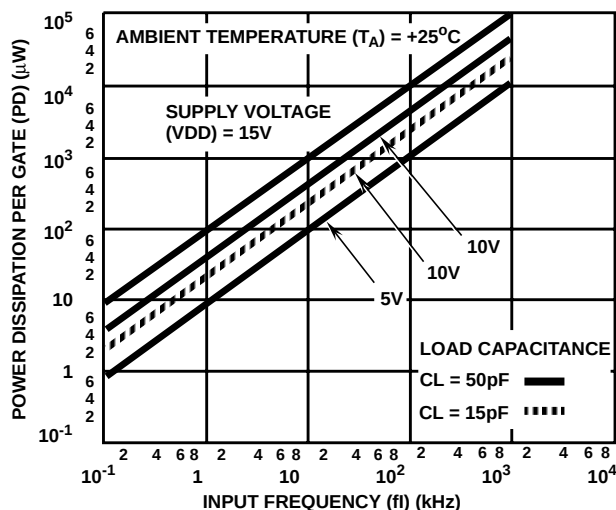
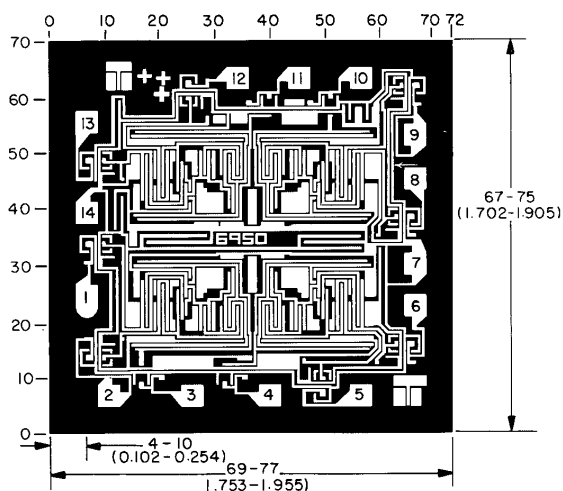


FIGURE 9. TYPICAL DYNAMIC POWER DISSIPATION AS A FUNCTION OF INPUT FREQUENCY

### 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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