

## 5409/DM7409 Quad 2-Input AND Gates with Open-Collector Outputs

### General Description

This device contains four independent gates each of which performs the logic AND function. The open-collector outputs require external pull-up resistors for proper logical operation.

### Pull-Up Resistor Equations

$$R_{MAX} = \frac{V_{CC} (Min) - V_{OH}}{N_1 (I_{OH}) + N_2 (I_{IH})}$$

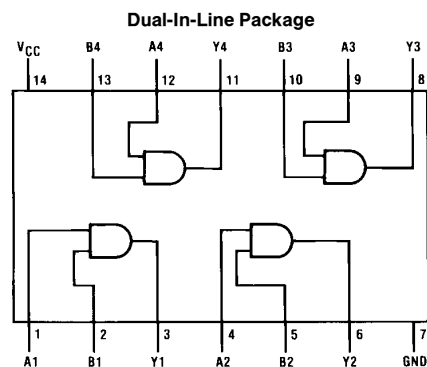
$$R_{MIN} = \frac{V_{CC} (Max) - V_{OL}}{I_{OL} - N_3 (I_{IL})}$$

Where:  $N_1 (I_{OH})$  = total maximum output high current for all outputs tied to pull-up resistor

$N_2 (I_{IH})$  = total maximum input high current for all inputs tied to pull-up resistor

$N_3 (I_{IL})$  = total maximum input low current for all inputs tied to pull-up resistor

### Connection Diagram



TL/F/6499-1

Order Number 5409DMQB, 5409FMB or DM7409N  
See NS Package Number J14A, N14A or W14B

### Function Table

$$Y = AB$$

| Inputs |   | Output |
|--------|---|--------|
| A      | B | Y      |
| L      | L | L      |
| L      | H | L      |
| H      | L | L      |
| H      | H | H      |

H = High Logic Level

L = Low Logic Level

## Absolute Maximum Ratings (Note)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|                                      |                 |
|--------------------------------------|-----------------|
| Supply Voltage                       | 7V              |
| Input Voltage                        | 5.5V            |
| Output Voltage                       | 7V              |
| Operating Free Air Temperature Range |                 |
| 54                                   | −55°C to +125°C |
| DM74                                 | 0°C to +70°C    |
| Storage Temperature Range            | −65°C to +150°C |

Note: The “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the “Electrical Characteristics” table are not guaranteed at the absolute maximum ratings. The “Recommended Operating Conditions” table will define the conditions for actual device operation.

## Recommended Operating Conditions

| Symbol          | Parameter                      | 5409 |     |     | DM7409 |     |      | Units |
|-----------------|--------------------------------|------|-----|-----|--------|-----|------|-------|
|                 |                                | Min  | Nom | Max | Min    | Nom | Max  |       |
| V <sub>CC</sub> | Supply Voltage                 | 4.5  | 5   | 5.5 | 4.75   | 5   | 5.25 | V     |
| V <sub>IH</sub> | High Level Input Voltage       | 2    |     |     | 2      |     |      | V     |
| V <sub>IL</sub> | Low Level Input Voltage        |      |     | 0.8 |        |     | 0.8  | V     |
| V <sub>OH</sub> | High Level Output Voltage      |      |     | 5.5 |        |     | 5.5  | V     |
| I <sub>OL</sub> | Low Level Output Current       |      |     | 16  |        |     | 16   | mA    |
| T <sub>A</sub>  | Free Air Operating Temperature | −55  |     | 125 | 0      |     | 70   | °C    |

## Electrical Characteristics over recommended operating free air temperature range (unless otherwise noted)

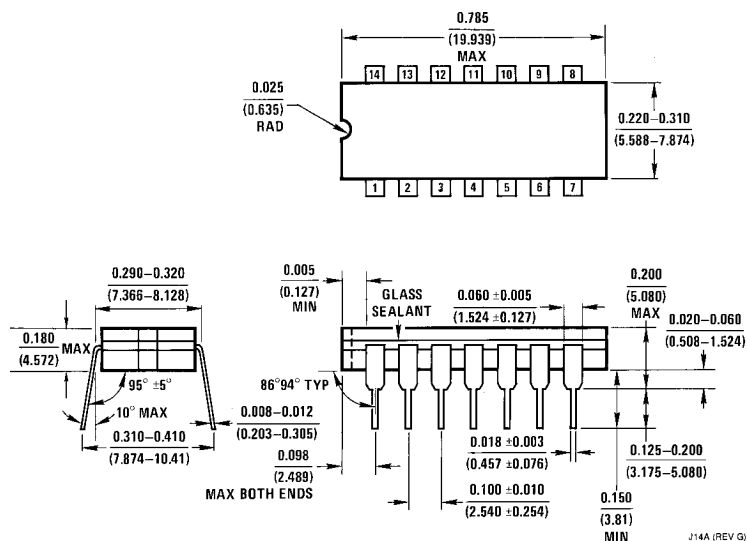
| Symbol           | Parameter                         | Conditions                                                            | Min | Typ<br>(Note 1) | Max  | Units |
|------------------|-----------------------------------|-----------------------------------------------------------------------|-----|-----------------|------|-------|
| V <sub>I</sub>   | Input Clamp Voltage               | V <sub>CC</sub> = Min, I <sub>I</sub> = −12 mA                        |     |                 | −1.5 | V     |
| I <sub>CEX</sub> | High Level Output Current         | V <sub>CC</sub> = Min, V <sub>O</sub> = 5.5V<br>V <sub>IH</sub> = Min |     |                 | 250  | μA    |
| V <sub>OL</sub>  | Low Level Output Voltage          | V <sub>CC</sub> = Min, I <sub>OL</sub> = Max<br>V <sub>IL</sub> = Max |     | 0.2             | 0.4  | V     |
| I <sub>I</sub>   | Input Current @ Max Input Voltage | V <sub>CC</sub> = Max, V <sub>I</sub> = 5.5V                          |     |                 | 1    | mA    |
| I <sub>IH</sub>  | High Level Input Current          | V <sub>CC</sub> = Max, V <sub>I</sub> = 2.4V                          |     |                 | 40   | μA    |
| I <sub>IL</sub>  | Low Level Input Current           | V <sub>CC</sub> = Max, V <sub>I</sub> = 0.4V                          |     |                 | −1.6 | mA    |
| I <sub>COH</sub> | Supply Current with Outputs High  | V <sub>CC</sub> = Max                                                 |     | 11              | 21   | mA    |
| I <sub>CCL</sub> | Supply Current with Outputs Low   | V <sub>CC</sub> = Max                                                 |     | 20              | 33   | mA    |

## Switching Characteristics at V<sub>CC</sub> = 5V and T<sub>A</sub> = 25°C (See Section 1 for Test Waveforms and Output Load)

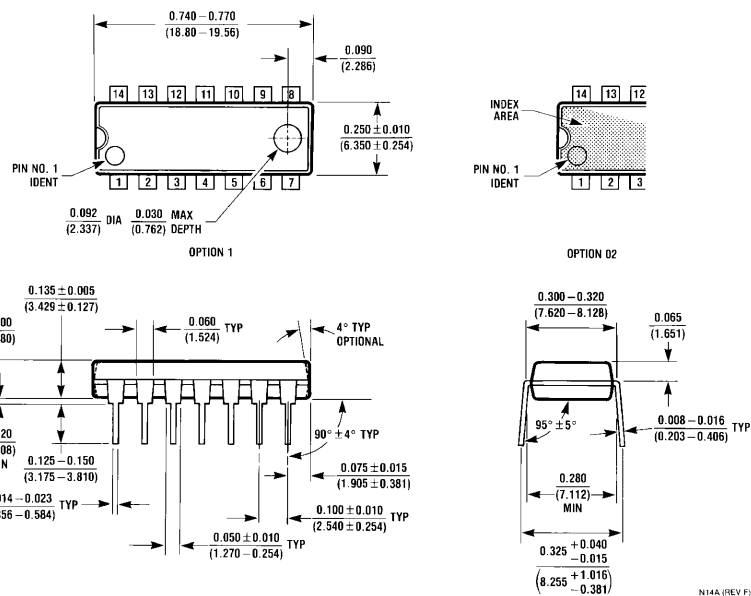
| Symbol           | Parameter                                          | Conditions                                      | Min | Max | Units |
|------------------|----------------------------------------------------|-------------------------------------------------|-----|-----|-------|
| t <sub>PLH</sub> | Propagation Delay Time<br>Low to High Level Output | C <sub>L</sub> = 15 pF<br>R <sub>L</sub> = 400Ω |     | 32  | ns    |
| t <sub>PHL</sub> | Propagation Delay Time<br>High to Low Level Output |                                                 |     | 24  | ns    |

Note 1: All typicals are at V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C.

### Physical Dimensions inches (millimeters)

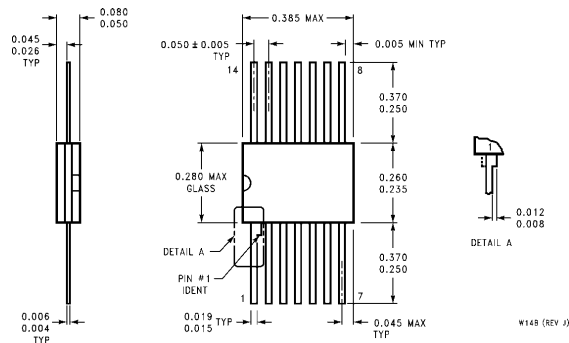


**14-Lead Ceramic Dual-In-Line Package (J)**  
**Order Number 5409DMQB**  
**NS Package Number J14A**



**14-Lead Molded Dual-In-Line Package (N)**  
**Order Number DM7409N**  
**NS Package Number N14A**

Physical Dimensions inches (millimeters) (Continued)



14-Lead Ceramic Flat Package (W)  
Order Number 5409FMQB  
NS Package Number W14B

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