

## 54LS09/DM54LS09/DM74LS09 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.

### Features

- Alternate Military/Aerospace device (54LS09) is available. Contact a National Semiconductor Sales Office/Distributor for specifications.

### Pull-Up Resistor Equations

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

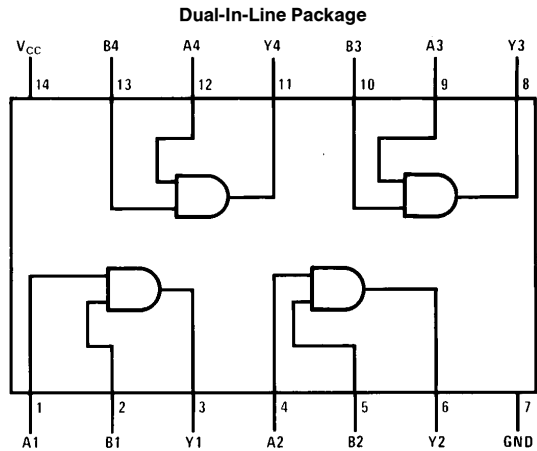
$$R_{MIN} = \frac{V_{CC} (Max) - V_{OL}}{I_{OL} - N_3 (I_{IL})}$$

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/6348-1

Order Number 54LS09DMQB, 54LS09FMQB, DM54LS09J, DM54LS09W, DM74LS09M or DM74LS09N  
See NS Package Number E20A, J14A, M14A, 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	7V
Output Voltage	7V
Operating Free Air Temperature Range	
DM54LS and 54LS	−55°C to +125°C
DM74LS	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	DM54LS09			DM74LS09			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			0.7			0.8	V
V <sub>OH</sub>	High Level Output Voltage			5.5			5.5	V
I <sub>OL</sub>	Low Level Output Current			4			8	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 (Note 1)	Max	Units
V <sub>I</sub>	Input Clamp Voltage	V <sub>CC</sub> = Min, I <sub>I</sub> = −18 mA			−1.5	V
I <sub>CEX</sub>	High Level Output Current	V <sub>CC</sub> = Min, V <sub>O</sub> = 5.5V V <sub>IH</sub> = Min			100	μA
V <sub>OL</sub>	Low Level Output Voltage	V <sub>CC</sub> = Min, I <sub>OL</sub> = Max	DM54	0.25	0.4	V
		V <sub>IL</sub> = Max	DM74	0.35	0.5	
		I <sub>OL</sub> = 4 mA, V <sub>CC</sub> = Min	DM74	0.25	0.4	
I <sub>I</sub>	Input Current @Max Input Voltage	V <sub>CC</sub> = Max, V <sub>I</sub> = 7V			0.1	mA
I <sub>IH</sub>	High Level Input Current	V <sub>CC</sub> = Max, V <sub>I</sub> = 2.7V			20	μA
I <sub>IL</sub>	Low Level Input Current	V <sub>CC</sub> = Max, V <sub>I</sub> = 0.4V			−0.36	mA
I <sub>CCH</sub>	Supply Current With Outputs High	V <sub>CC</sub> = Max		2.4	4.8	mA
I <sub>CCL</sub>	Supply Current With Outputs Low	V <sub>CC</sub> = Max		4.4	8.8	mA

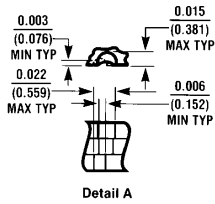
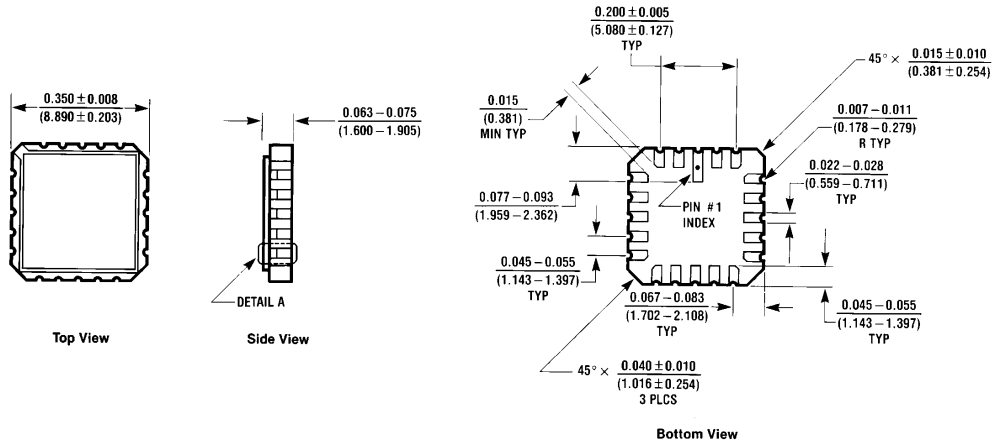
## Switching Characteristics at V<sub>CC</sub> = 5V and T<sub>A</sub> = 25°C (See Section 1 for Test Waveforms and Output Load)

Symbol	Parameter	R <sub>L</sub> = 2 kΩ				Units
		C <sub>L</sub> = 15 pF		C <sub>L</sub> = 50 pF		
		Min	Max	Min	Max	
t <sub>PLH</sub>	Propagation Delay Time Low to High Level Output	5	20	8	45	ns
t <sub>PHL</sub>	Propagation Delay Time High to Low Level Output	4	15	6	27	ns

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

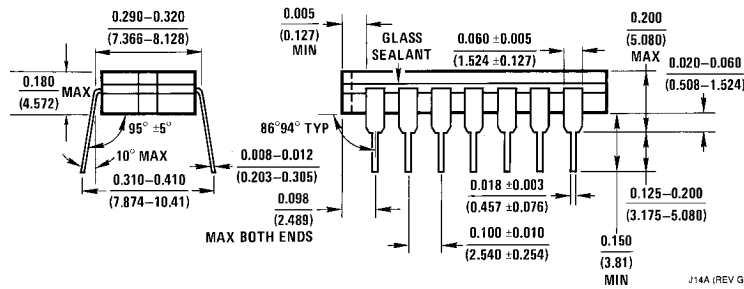
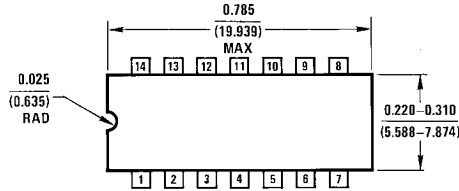


**Physical Dimensions** inches (millimeters)



**Ceramic Leadless Chip Carrier Package (E)**  
**Order Number 54LS09LMQB**  
**NS Package Number E20A**

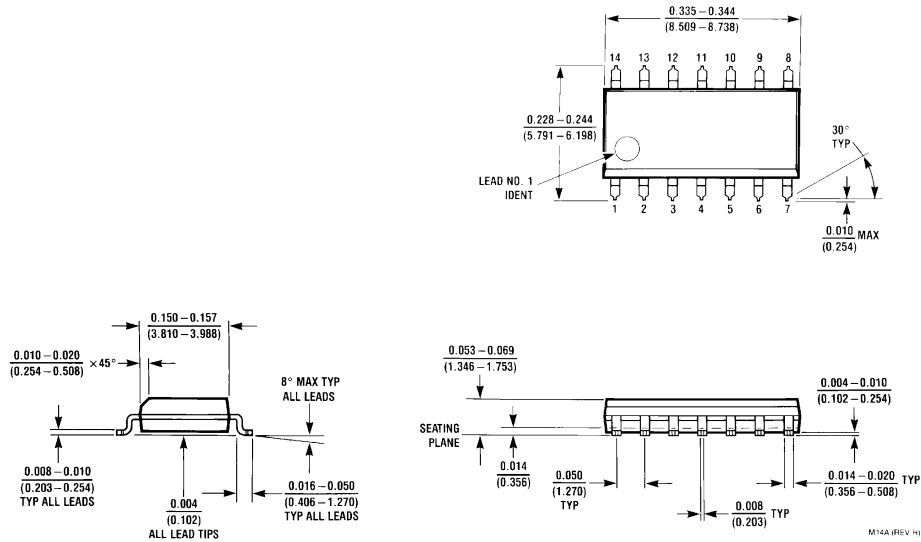
E20A (REV D)



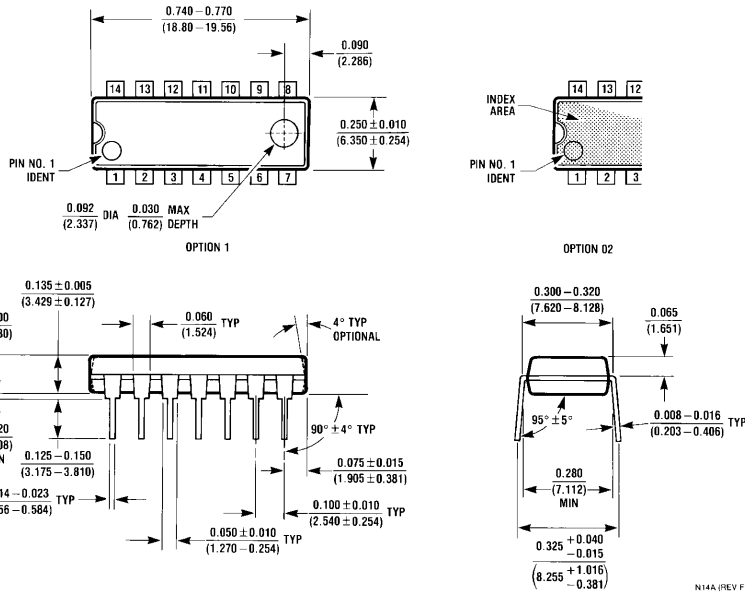
**14-Lead Ceramic Dual-In-Line Package (J)**  
**Order Number 54LS09DMQB or DM54LS09J**  
**NS Package Number J14A**

J14A (REV G)

**Physical Dimensions** inches (millimeters) (Continued)

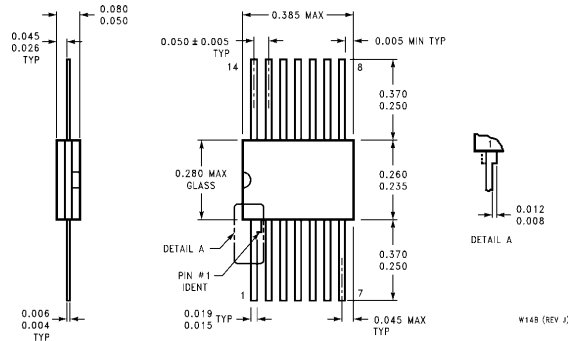


**14-Lead Small Outline Molded Package (M)**  
**Order Number DM74LS09M**  
**NS Package Number M14A**



**14-Lead Molded Dual-In-Line Package (N)**  
**Order Number DM74LS09N**  
**NS Package Number N14A**

**Physical Dimensions** inches (millimeters) (Continued)



**14-Lead Ceramic Flat Package (W)**  
**Order Number 54LS09FMQB or DM54LS09W**  
**NS Package Number W14B**

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