

# SN74LS109A

## Dual JK Positive Edge-Triggered Flip-Flop

The SN74LS109A consists of two high speed completely independent transition clocked JK flip-flops. The clocking operation is independent of rise and fall times of the clock waveform. The JK design allows operation as a D flip-flop by simply connecting the J and K pins together.

MODE SELECT – TRUTH TABLE

| OPERATING MODE   | INPUTS           |                  |   |   | OUTPUTS        |                |
|------------------|------------------|------------------|---|---|----------------|----------------|
|                  | $\overline{S}_D$ | $\overline{C}_D$ | J | K | Q              | $\overline{Q}$ |
| Set              | L                | H                | X | X | H              | L              |
| Reset (Clear)    | H                | L                | X | X | L              | H              |
| *Undetermined    | L                | L                | X | X | H              | H              |
| Load "1" (Set)   | H                | H                | h | h | H              | L              |
| Hold             | H                | H                | l | h | q              | $\overline{q}$ |
| Toggle           | H                | H                | h | l | $\overline{q}$ | q              |
| Load "0" (Reset) | H                | H                | l | l | L              | H              |

\* Both outputs will be HIGH while both  $\overline{S}_D$  and  $\overline{C}_D$  are LOW, but the output states are unpredictable if  $\overline{S}_D$  and  $\overline{C}_D$  go HIGH simultaneously.

H, h = HIGH Voltage Level

L, l = LOW Voltage Level

X = Don't Care

l, h (q) = Lower case letters indicate the state of the referenced input

(or output) one set-up time prior to the LOW to HIGH clock transition.

GUARANTEED OPERATING RANGES

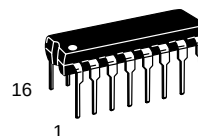
| Symbol   | Parameter                           | Min  | Typ | Max  | Unit |
|----------|-------------------------------------|------|-----|------|------|
| $V_{CC}$ | Supply Voltage                      | 4.75 | 5.0 | 5.25 | V    |
| $T_A$    | Operating Ambient Temperature Range | 0    | 25  | 70   | °C   |
| $I_{OH}$ | Output Current – High               |      |     | –0.4 | mA   |
| $I_{OL}$ | Output Current – Low                |      |     | 8.0  | mA   |



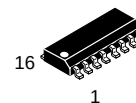
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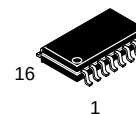
LOW  
POWER  
SCHOTTKY



PLASTIC  
N SUFFIX  
CASE 648



SOIC  
D SUFFIX  
CASE 751B



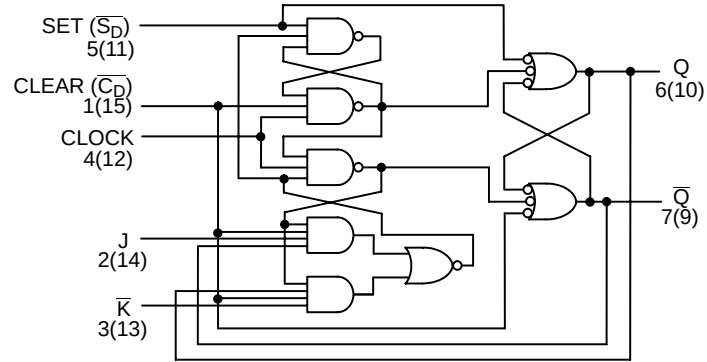
SOEIAJ  
M SUFFIX  
CASE 966

ORDERING INFORMATION

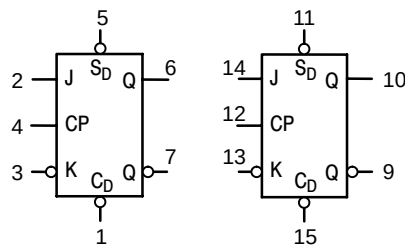
| Device        | Package    | Shipping         |
|---------------|------------|------------------|
| SN74LS109AN   | 16 Pin DIP | 2000 Units/Box   |
| SN74LS109AD   | SOIC–16    | 38 Units/Rail    |
| SN74LS109ADR2 | SOIC–16    | 2500/Tape & Reel |
| SN74LS109AM   | SOEIAJ–16  | See Note 1       |
| SN74LS109AMEL | SOEIAJ–16  | See Note 1       |

1. For ordering information on the EIAJ version of the SOIC package, please contact your local ON Semiconductor representative.

## LOGIC DIAGRAM



## LOGIC SYMBOL



$V_{CC}$  = PIN 16  
GND = PIN 8

## DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

| Symbol          | Parameter                                                | Limits |       |              | Unit | Test Conditions                                                                                                    |                                                                                                             |
|-----------------|----------------------------------------------------------|--------|-------|--------------|------|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
|                 |                                                          | Min    | Typ   | Max          |      |                                                                                                                    |                                                                                                             |
| V <sub>IH</sub> | Input HIGH Voltage                                       | 2.0    |       |              | V    | Guaranteed Input HIGH Voltage for All Inputs                                                                       |                                                                                                             |
| V <sub>IL</sub> | Input LOW Voltage                                        |        |       | 0.8          | V    | Guaranteed Input LOW Voltage for All Inputs                                                                        |                                                                                                             |
| V <sub>IK</sub> | Input Clamp Diode Voltage                                |        | −0.65 | −1.5         | V    | V <sub>CC</sub> = MIN, I <sub>IN</sub> = −18 mA                                                                    |                                                                                                             |
| V <sub>OH</sub> | Output HIGH Voltage                                      | 2.7    | 3.5   |              | V    | V <sub>CC</sub> = MIN, I <sub>OH</sub> = MAX, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> per Truth Table |                                                                                                             |
| V <sub>OL</sub> | Output LOW Voltage                                       |        | 0.25  | 0.4          | V    | I <sub>OL</sub> = 4.0 mA                                                                                           | V <sub>CC</sub> = V <sub>CC</sub> MIN, V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> per Truth Table |
|                 |                                                          |        | 0.35  | 0.5          | V    | I <sub>OL</sub> = 8.0 mA                                                                                           |                                                                                                             |
| I <sub>IH</sub> | Input HIGH Current<br>J, $\bar{K}$ , Clock<br>Set, Clear |        |       | 20<br>40     | μA   | V <sub>CC</sub> = MAX, V <sub>IN</sub> = 2.7 V                                                                     |                                                                                                             |
|                 | J, $\bar{K}$ , Clock<br>Set, Clear                       |        |       | 0.1<br>0.2   | mA   | V <sub>CC</sub> = MAX, V <sub>IN</sub> = 7.0 V                                                                     |                                                                                                             |
| I <sub>IL</sub> | Input LOW Current<br>J, $\bar{K}$ , Clock<br>Set, Clear  |        |       | −0.4<br>−0.8 | mA   | V <sub>CC</sub> = MAX, V <sub>IN</sub> = 0.4 V                                                                     |                                                                                                             |
| I <sub>OS</sub> | Output Short Circuit Current (Note 1)                    | −20    |       | −100         | mA   | V <sub>CC</sub> = MAX                                                                                              |                                                                                                             |
| I <sub>CC</sub> | Power Supply Current                                     |        |       | 8.0          | mA   | V <sub>CC</sub> = MAX                                                                                              |                                                                                                             |

Note 1: Not more than one output should be shorted at a time, nor for more than 1 second.

**AC CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 5.0\text{ V}$ )

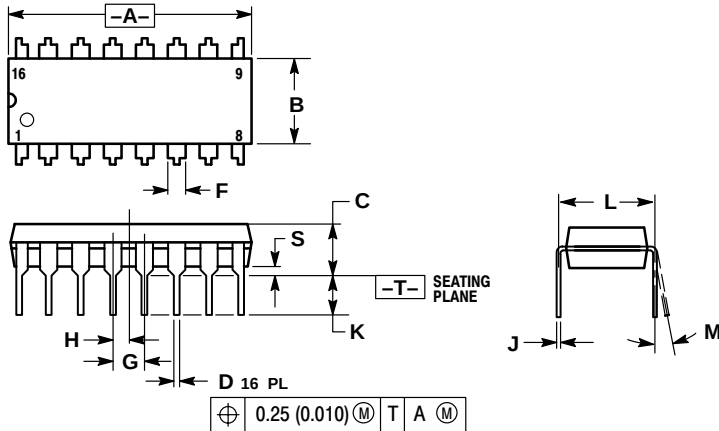
| Symbol           | Parameter                   | Limits |     |     | Unit | Test Conditions                                 |
|------------------|-----------------------------|--------|-----|-----|------|-------------------------------------------------|
|                  |                             | Min    | Typ | Max |      |                                                 |
| $f_{\text{MAX}}$ | Maximum Clock Frequency     | 25     | 33  |     | MHz  | $V_{CC} = 5.0\text{ V}$<br>$C_L = 15\text{ pF}$ |
| $t_{\text{PLH}}$ | Clock, Clear, Set to Output |        | 13  | 25  | ns   |                                                 |
| $t_{\text{PHL}}$ |                             |        | 25  | 40  | ns   |                                                 |

**AC SETUP REQUIREMENTS** ( $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 5.0\text{ V}$ )

| Symbol | Parameter                         | Limits |     |     | Unit | Test Conditions         |
|--------|-----------------------------------|--------|-----|-----|------|-------------------------|
|        |                                   | Min    | Typ | Max |      |                         |
| $t_W$  | Clock High Clear, Set Pulse Width | 25     |     |     | ns   | $V_{CC} = 5.0\text{ V}$ |
| $t_s$  | Data Setup Time — HIGH<br>LOW     | 20     |     |     | ns   |                         |
|        |                                   | 20     |     |     | ns   |                         |
| $t_h$  | Hold time                         | 5.0    |     |     | ns   |                         |

## PACKAGE DIMENSIONS

### N SUFFIX PLASTIC PACKAGE CASE 648-08 ISSUE R

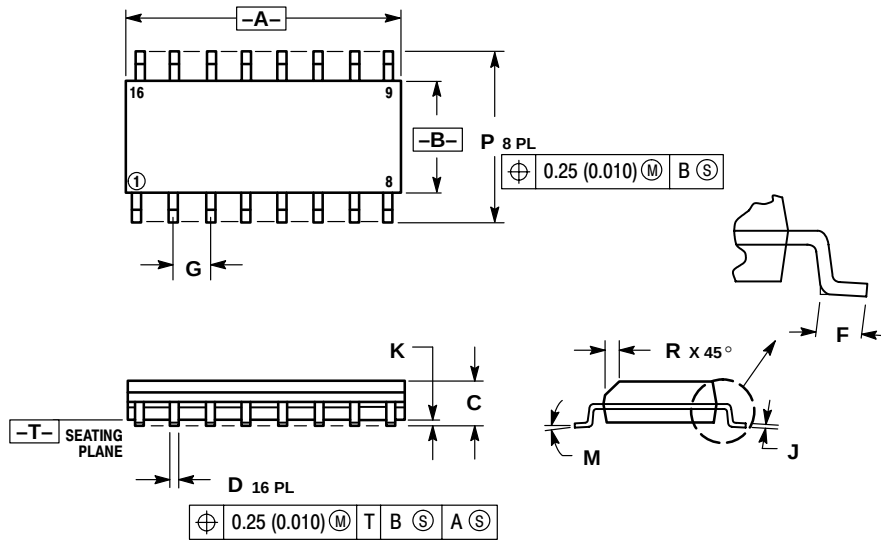


#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.740     | 0.770 | 18.80       | 19.55 |
| B   | 0.250     | 0.270 | 6.35        | 6.85  |
| C   | 0.145     | 0.175 | 3.69        | 4.44  |
| D   | 0.015     | 0.021 | 0.39        | 0.53  |
| F   | 0.040     | 0.70  | 1.02        | 1.77  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.050 BSC |       | 1.27 BSC    |       |
| J   | 0.008     | 0.015 | 0.21        | 0.38  |
| K   | 0.110     | 0.130 | 2.80        | 3.30  |
| L   | 0.295     | 0.305 | 7.50        | 7.74  |
| M   | 0°        | 10°   | 0°          | 10°   |
| S   | 0.020     | 0.040 | 0.51        | 1.01  |

### D SUFFIX PLASTIC SOIC PACKAGE CASE 751B-05 ISSUE J



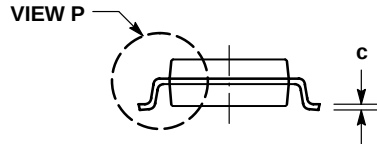
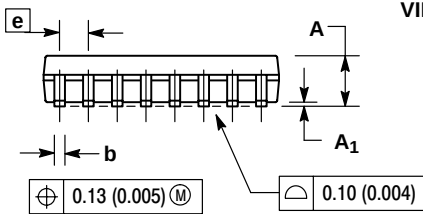
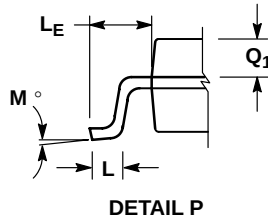
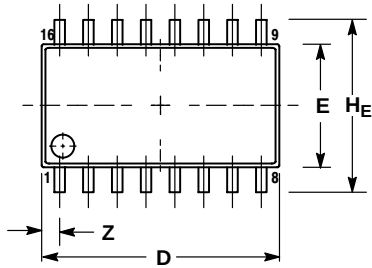
#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 9.80        | 10.00 | 0.386     | 0.393 |
| B   | 3.80        | 4.00  | 0.150     | 0.157 |
| C   | 1.35        | 1.75  | 0.054     | 0.068 |
| D   | 0.35        | 0.49  | 0.014     | 0.019 |
| F   | 0.40        | 1.25  | 0.016     | 0.049 |
| G   | 1.27 BSC    |       | 0.050 BSC |       |
| J   | 0.19        | 0.25  | 0.008     | 0.009 |
| K   | 0.10        | 0.25  | 0.004     | 0.009 |
| M   | 0°          | 7°    | 0°        | 7°    |
| P   | 5.80        | 6.20  | 0.229     | 0.244 |
| R   | 0.25        | 0.50  | 0.010     | 0.019 |

## PACKAGE DIMENSIONS

### M SUFFIX SOEIAJ PACKAGE CASE 966-01 ISSUE O



#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

| DIM            | MILLIMETERS |       | INCHES    |       |
|----------------|-------------|-------|-----------|-------|
|                | MIN         | MAX   | MIN       | MAX   |
| A              | ---         | 2.05  | ---       | 0.081 |
| A <sub>1</sub> | 0.05        | 0.20  | 0.002     | 0.008 |
| b              | 0.35        | 0.50  | 0.014     | 0.020 |
| c              | 0.18        | 0.27  | 0.007     | 0.011 |
| D              | 9.90        | 10.50 | 0.390     | 0.413 |
| E              | 5.10        | 5.45  | 0.201     | 0.215 |
| e              | 1.27 BSC    |       | 0.050 BSC |       |
| H <sub>E</sub> | 7.40        | 8.20  | 0.291     | 0.323 |
| L              | 0.50        | 0.85  | 0.020     | 0.033 |
| L <sub>E</sub> | 1.10        | 1.50  | 0.043     | 0.059 |
| M              | 0 °         | 10 °  | 0 °       | 10 °  |
| Q <sub>1</sub> | 0.70        | 0.90  | 0.028     | 0.035 |
| Z              | ---         | 0.78  | ---       | 0.031 |

## **Notes**

## **Notes**

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