

## DM74ALS109A

### Dual J-K Positive-Edge-Triggered Flip-Flop with Preset and Clear

#### General Description

The DM74ALS109A is a dual edge-triggered flip-flop. Each flip-flop has individual J,  $\bar{K}$ , clock, clear and preset inputs, and also complementary Q and  $\bar{Q}$  outputs.

Information at input J or  $\bar{K}$  is transferred to the Q output on the positive going edge of the clock pulse. Clock triggering occurs at a voltage level of the clock pulse and is not directly related to the transition time of the positive going pulse. When the clock input is at either the HIGH or LOW level, the J,  $\bar{K}$  input signal has no effect.

Asynchronous preset and clear inputs will set or clear Q output respectively upon the application of low level signal.

The J- $\bar{K}$  design allows operation as a D flip-flop by tying the J and  $\bar{K}$  inputs together.

#### Features

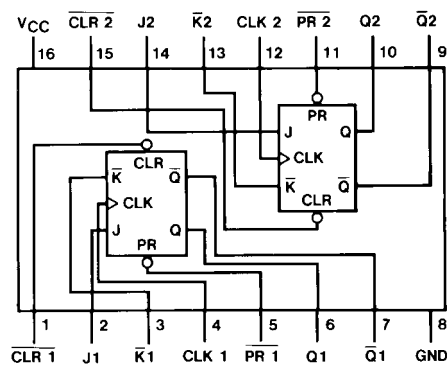
- Switching specifications at 50 pF
- Switching specifications guaranteed over full temperature and  $V_{CC}$  range
- Advanced oxide-isolated, ion-implanted Schottky TTL process
- Functionally and pin for pin compatible with Schottky and LS TTL counterpart
- Improved AC performance over LS109 at approximately half the power

#### Ordering Code:

| Order Number | Package Number | Package Description                                                         |
|--------------|----------------|-----------------------------------------------------------------------------|
| DM74ALS109AM | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow |
| DM74ALS109AN | N16E           | 16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide       |

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

#### Connection Diagram



#### Function Table

| Inputs |     |    |   |           | Outputs    |             |
|--------|-----|----|---|-----------|------------|-------------|
| PR     | CLR | CK | J | $\bar{K}$ | Q          | $\bar{Q}$   |
| L      | H   | X  | X | X         | H          | L           |
| H      | L   | X  | X | X         | L          | H           |
| L      | L   | X  | X | X         | H (Note 1) | H (Note 1)  |
| H      | H   | ↑  | L | L         | L          | H           |
| H      | H   | ↑  | H | L         | TOGGLE     |             |
| H      | H   | ↑  | L | H         | $Q_0$      | $\bar{Q}_0$ |
| H      | H   | ↑  | H | H         | H          | L           |
| H      | H   | L  | X | X         | $Q_0$      | $\bar{Q}_0$ |

L = LOW State

H = HIGH State

X = Don't Care

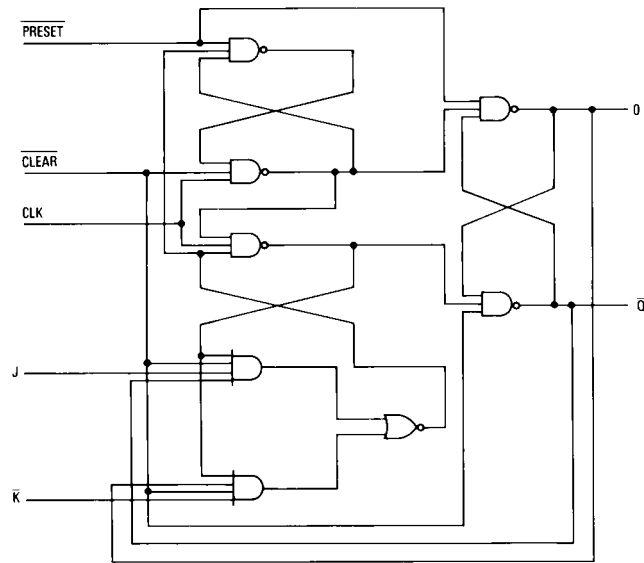
↑ = Positive Edge Transition,

$Q_0$  = Previous Condition of Q

**Note 1:** This condition is nonstable; it will not persist when present and clear inputs return to their inactive (HIGH) level. The output levels in this condition are not guaranteed to meet the  $V_{OH}$  specification.

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## Logic Diagram



**Absolute Maximum Ratings**(Note 2)

|                                      |                 |
|--------------------------------------|-----------------|
| Supply Voltage                       | 7V              |
| Input Voltage                        | 7V              |
| Operating Free Air Temperature Range | 0°C to +70°C    |
| Storage Temperature Range            | −65°C to +150°C |
| Typical $\theta_{JA}$                |                 |
| N Package                            | 82.5°C/W        |
| M Package                            | 111.5°C/W       |

**Note 2:** 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 tables 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                      |                                               | Min           | Nom | Max  | Units |
|--------------|--------------------------------|-----------------------------------------------|---------------|-----|------|-------|
| $V_{CC}$     | Supply Voltage                 |                                               | 4.5           | 5   | 5.5  | V     |
| $V_{IH}$     | HIGH Level Input Voltage       |                                               | 2             |     |      | V     |
| $V_{IL}$     | LOW Level Input Voltage        |                                               |               |     | 0.8  | V     |
| $I_{OH}$     | HIGH Level Output Current      |                                               |               |     | −0.4 | mA    |
| $I_{OL}$     | LOW Level Output Current       |                                               |               |     | 8    | mA    |
| $f_{CLK}$    | Clock Frequency                |                                               | 0             |     | 34   | MHz   |
| $t_{W(CLK)}$ | Pulse Width                    | Clock HIGH                                    | 14.5          |     |      | ns    |
|              |                                | Clock LOW                                     | 14.5          |     |      | ns    |
| $t_W$        | Pulse Width (Note 3)           | Preset and $\overline{Clear}$                 | 15            |     |      | ns    |
| $t_{SU}$     | Data Setup Time<br>(Note 3)    | J or $\overline{K}$                           | 15 $\uparrow$ |     |      | ns    |
|              |                                | $\overline{PRE}$ or $\overline{CLR}$ inactive | 10 $\uparrow$ |     |      |       |
| $t_H$        | Data Hold Time                 |                                               | 0 $\uparrow$  |     |      | ns    |
| $T_A$        | Free Air Operating Temperature |                                               | 0             |     | 70   | °C    |

**Note 3:** The ( $\uparrow$ ) arrow indicates the positive edge of the Clock is used for reference.

## Electrical Characteristics

over recommended operating free-air temperature range. All typical values are measured at  $V_{CC} = 5V$ ,  $T_A = 25^\circ C$ .

| Symbol         | Parameter                             | Conditions                                                | Min                                                    | Typ  | Max  | Units   |
|----------------|---------------------------------------|-----------------------------------------------------------|--------------------------------------------------------|------|------|---------|
| $V_{IK}$       | Input Clamp Voltage                   | $V_{CC} = 4.5V$ , $I_I = -18\text{ mA}$                   |                                                        |      | -1.5 | V       |
| $V_{OH}$       | HIGH Level<br>Output Voltage          | $I_{OH} = -400\text{ }\mu A$<br>$V_{CC} = 4.5V$ to $5.5V$ | $V_{CC} - 2$                                           |      |      | V       |
| $V_{OL}$       | LOW Level<br>Output Voltage           | $V_{CC} = 4.5V$<br>$V_{IH} = 2V$                          | $I_{OL} = 4\text{ mA}$                                 | 0.25 | 0.4  | V       |
|                |                                       |                                                           | $I_{OL} = 8\text{ mA}$                                 | 0.35 | 0.5  | V       |
| $I_I$          | Input Current at Max<br>Input Voltage | $V_{CC} = 5.5V$ ,<br>$V_{IH} = 7V$                        | Clock, J, $\overline{K}$                               |      | 0.1  | mA      |
|                |                                       |                                                           | $\overline{\text{Preset}}$ , $\overline{\text{Clear}}$ |      | 0.2  |         |
| $I_{IH}$       | High Level<br>Input Current           | $V_{CC} = 5.5V$ ,<br>$V_{IH} = 2.7V$                      | Clock, J, $\overline{K}$                               |      | 20   | $\mu A$ |
|                |                                       |                                                           | $\overline{\text{Preset}}$ , $\overline{\text{Clear}}$ |      | 40   |         |
| $I_{IL}$       | Low Level<br>Input Current            | $V_{CC} = 5.5V$ ,<br>$V_{IL} = 0.4V$                      | Clock, J, $\overline{K}$                               |      | -0.2 | mA      |
|                |                                       |                                                           | $\overline{\text{Preset}}$ , $\overline{\text{Clear}}$ |      | -0.4 |         |
| $I_O$ (Note 4) | Output Drive Current                  | $V_{CC} = 5.5V$ , $V_O = 2.25V$                           | -30                                                    |      | -112 | mA      |
| $I_{CC}$       | Supply Current                        | $V_{CC} = 5.5V$ (Note 5)                                  |                                                        | 2.4  | 4    | mA      |

**Note 4:** The output conditions have been chosen to produce a current that closely approximates one half of the true short circuit output current,  $I_{OS}$ .

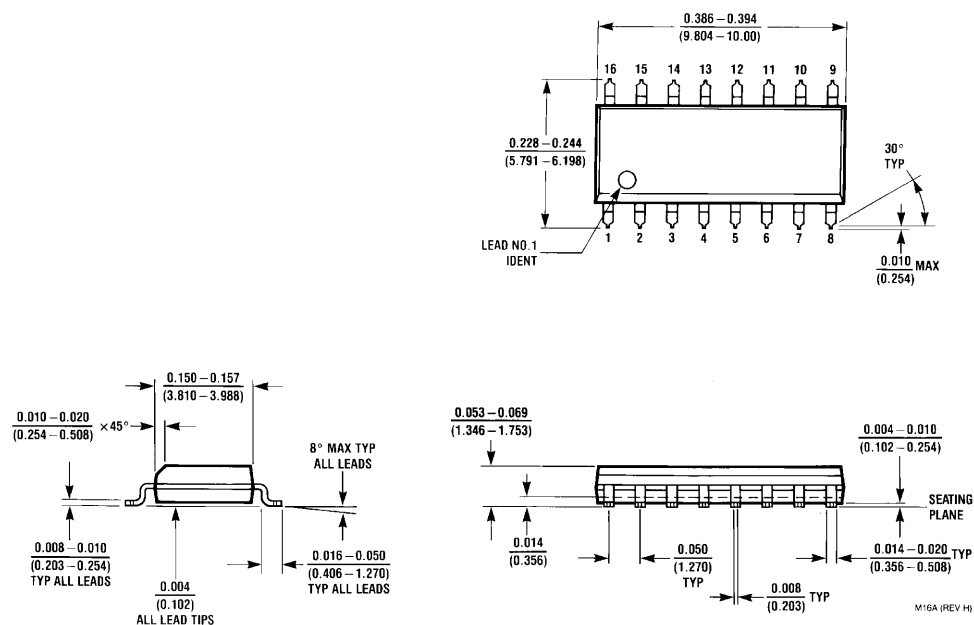
**Note 5:**  $I_{CC}$  is measured with J,  $\overline{K}$ , CLK and  $\overline{\text{PRESET}}$  grounded, then with J,  $\overline{K}$ , CLK and  $\overline{\text{CLEAR}}$  grounded.

## Switching Characteristics

over recommended operating free air temperature range

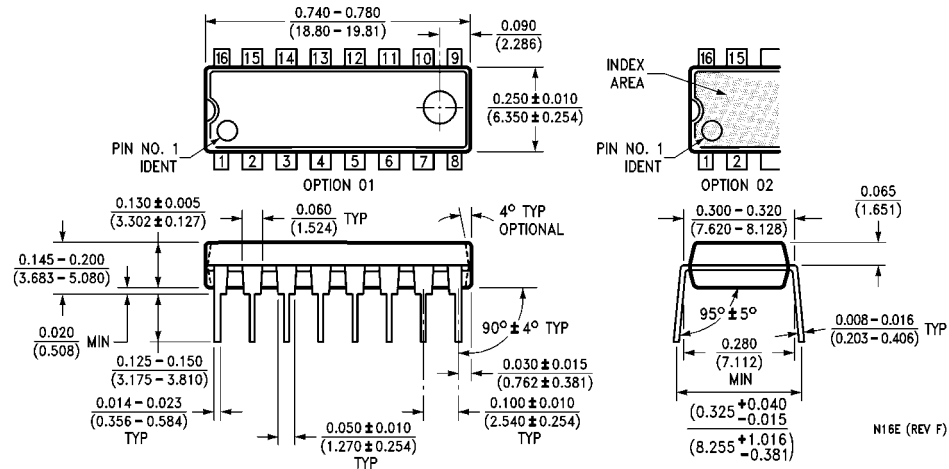
| Symbol    | Parameter                                          | Conditions                                | From                                                    | To                  | Min | Max | Units |
|-----------|----------------------------------------------------|-------------------------------------------|---------------------------------------------------------|---------------------|-----|-----|-------|
| $f_{MAX}$ | Maximum Clock Frequency                            | $V_{CC} = 4.5V$ to $5.5V$                 |                                                         |                     | 34  |     | MHz   |
| $t_{PLH}$ | Propagation Delay Time<br>LOW-to-HIGH Level Output | $R_L = 500\Omega$<br>$C_L = 50\text{ pF}$ | $\overline{\text{Preset}}$ or $\overline{\text{Clear}}$ | Q or $\overline{Q}$ | 3   | 13  | ns    |
| $t_{PHL}$ | Propagation Delay Time<br>HIGH-to-LOW Level Output |                                           | $\overline{\text{Preset}}$ or $\overline{\text{Clear}}$ | Q or $\overline{Q}$ | 5   | 15  | ns    |
| $t_{PLH}$ | Propagation Delay Time<br>LOW-to-HIGH Level Output |                                           | Clock                                                   | Q or $\overline{Q}$ | 5   | 16  | ns    |
| $t_{PHL}$ | Propagation Delay Time<br>HIGH-to-LOW Level Output |                                           | Clock                                                   | Q or $\overline{Q}$ | 5   | 18  | ns    |
|           |                                                    |                                           |                                                         |                     |     |     |       |

**Physical Dimensions** inches (millimeters) unless otherwise noted



**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow Package Number M16A**

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide  
Package Number N16E

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