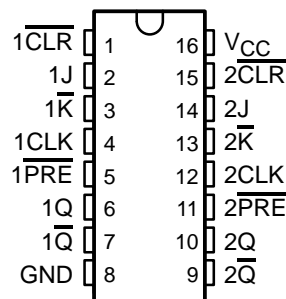


CD54AC109, CD74AC109 DUAL J- \bar{K} POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH CLEAR AND PRESET

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- AC Types Feature 1.5-V to 5.5-V Operation and Balanced Noise Immunity at 30% of the Supply Voltage
- Speed of Bipolar F, AS, and S, With Significantly Reduced Power Consumption
- Balanced Propagation Delays
- ± 24 -mA Output Drive Current
– Fanout to 15 F Devices
- SCR-Latchup-Resistant CMOS Process and Circuit Design
- Exceeds 2-kV ESD Protection Per MIL-STD-883, Method 3015

CD54AC109 . . . F PACKAGE
CD74AC109 . . . E OR M PACKAGE
(TOP VIEW)



description/ordering information

The 'AC109 devices contain two independent J- \bar{K} positive-edge-triggered flip-flops. A low level at the preset (\overline{PRE}) or clear (\overline{CLR}) inputs sets or resets the outputs, regardless of the levels of the other inputs. When \overline{PRE} and \overline{CLR} are inactive (high), data at the J and \bar{K} inputs meeting the setup-time requirements are transferred to the outputs on the positive-going edge of the clock (CLK) pulse. Clock triggering occurs at a voltage level and is not directly related to the rise time of the clock pulse. Following the hold-time interval, data at the J and \bar{K} inputs can be changed without affecting the levels at the outputs. These versatile flip-flops can perform as toggle flip-flops by grounding \bar{K} and tying J high. They also can perform as D-type flip-flops if J and \bar{K} are tied together.

ORDERING INFORMATION

| T _A | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|----------|---------------|-----------------------|------------------|
| –55°C to 125°C | PDIP – E | Tube | CD74AC109E | CD74AC109E |
| | SOIC – M | Tape and reel | CD74AC109M96 | AC109M |
| | CDIP – F | Tube | CD54AC109F3A | CD54AC109F3A |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

CD54AC109, CD74AC109 DUAL J-K POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH CLEAR AND PRESET

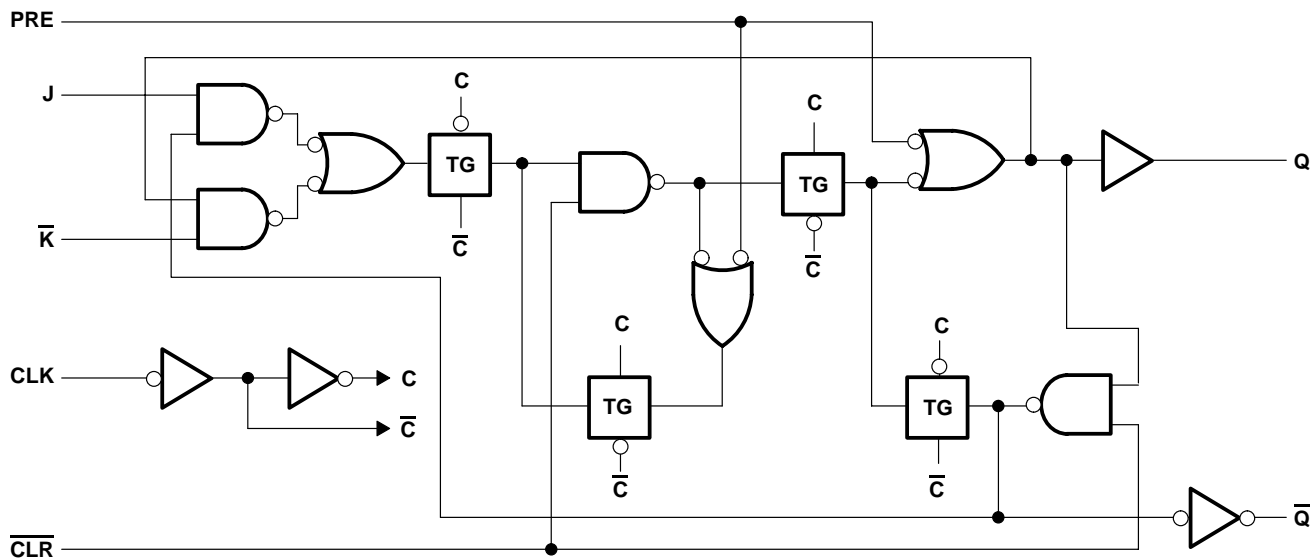
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FUNCTION TABLE
(each flip-flop)

| INPUTS | | | | | OUTPUTS | |
|-------------------------|-------------------------|-----|---|-----------------------|----------------|-------------------------|
| $\overline{\text{PRE}}$ | $\overline{\text{CLR}}$ | CLK | J | $\overline{\text{K}}$ | Q | $\overline{\text{Q}}$ |
| L | H | X | X | X | H | L |
| H | L | X | X | X | L | H |
| L | L | X | X | X | H [†] | H [†] |
| H | H | ↑ | L | L | L | H |
| H | H | ↑ | H | L | Toggle | |
| H | H | ↑ | L | H | Q ₀ | $\overline{\text{Q}}_0$ |
| H | H | ↑ | H | H | H | L |
| H | H | L | X | X | Q ₀ | $\overline{\text{Q}}_0$ |

[†] Unpredictable and unstable condition if both $\overline{\text{PRE}}$ and $\overline{\text{CLR}}$ go low simultaneously

logic diagram, each flip-flop (positive logic)



CD54AC109, CD74AC109 DUAL J-K̄ POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH CLEAR AND PRESET

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

| | |
|---|----------------|
| Supply voltage range, V_{CC} | –0.5 V to 6 V |
| Input clamp current, I_{IK} ($V_I < 0$ V or $V_I > V_{CC}$) (see Note 1) | ±20 mA |
| Output clamp current, I_{OK} ($V_O < 0$ V or $V_O > V_{CC}$) (see Note 1) | ±50 mA |
| Continuous output current, I_O ($V_O > 0$ V or $V_O < V_{CC}$) | ±50 mA |
| Continuous current through V_{CC} or GND | ±100 mA |
| Package thermal impedance, θ_{JA} (see Note 2): E package | 67°C/W |
| M package | 73°C/W |
| Storage temperature range, T_{stg} | –65°C to 150°C |

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 3)

| | | $T_A = 25^\circ\text{C}$ | | $-55^\circ\text{C to } 125^\circ\text{C}$ | | $-40^\circ\text{C to } 85^\circ\text{C}$ | | UNIT |
|---------------------|------------------------------------|---------------------------|----------|---|----------|--|----------|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| V_{CC} | Supply voltage | 1.5 | 5.5 | 1.5 | 5.5 | 1.5 | 5.5 | V |
| V_{IH} | High-level input voltage | $V_{CC} = 1.5$ V | | 1.2 | 1.2 | 1.2 | | V |
| | | $V_{CC} = 3$ V | | 2.1 | 2.1 | 2.1 | | |
| | | $V_{CC} = 5.5$ V | | 3.85 | 3.85 | 3.85 | | |
| V_{IL} | Low-level input voltage | $V_{CC} = 1.5$ V | | | 0.3 | | 0.3 | V |
| | | $V_{CC} = 3$ V | | | 0.9 | | 0.9 | |
| | | $V_{CC} = 5.5$ V | | | 1.65 | | 1.65 | |
| V_I | Input voltage | 0 | V_{CC} | 0 | V_{CC} | 0 | V_{CC} | V |
| V_O | Output voltage | 0 | V_{CC} | 0 | V_{CC} | 0 | V_{CC} | V |
| I_{OH} | High-level output current | $V_{CC} = 4.5$ V to 5.5 V | | –24 | –24 | –24 | | mA |
| I_{OL} | Low-level output current | $V_{CC} = 4.5$ V to 5.5 V | | 24 | 24 | 24 | | mA |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | $V_{CC} = 1.5$ V to 3 V | | 50 | 50 | 50 | | ns/V |
| | | $V_{CC} = 3.6$ V to 5.5 V | | 20 | 20 | 20 | | |

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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DUAL J-K POSITIVE-EDGE-TRIGGERED FLIP-FLOPS
WITH CLEAR AND PRESET

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | | V _{CC} | T _A = 25°C | | -55°C to 125°C | | -40°C to 85°C | | UNIT |
|---------------------------|---|---------------------------|-----------------|-----------------------|------|----------------|------|---------------|------|------|
| | | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| V _{OH} | V _I = V _{IH} or V _{IL} | I _{OH} = -50 μA | 1.5 V | 1.4 | | 1.4 | | 1.4 | | V |
| | | | 3 V | 2.9 | | 2.9 | | 2.9 | | |
| | | | 4.5 V | 4.4 | | 4.4 | | 4.4 | | |
| | | I _{OH} = -4 mA | 3 V | 2.58 | | 2.4 | | 2.48 | | |
| | | I _{OH} = -24 mA | 4.5 V | 3.94 | | 3.7 | | 3.8 | | |
| | | I _{OH} = -50 mA† | 5.5 V | | | 3.85 | | | | |
| I _{OH} = -75 mA† | 5.5 V | | | | | 3.85 | | | | |
| V _{OL} | V _I = V _{IH} or V _{IL} | I _{OL} = 50 μA | 1.5 V | | 0.1 | | 0.1 | | 0.1 | V |
| | | | 3 V | | 0.1 | | 0.1 | | 0.1 | |
| | | | 4.5 V | | 0.1 | | 0.1 | | 0.1 | |
| | | I _{OL} = 12 mA | 3 V | | 0.36 | | 0.5 | | 0.44 | |
| | | I _{OL} = 24 mA | 4.5 V | | 0.36 | | 0.5 | | 0.44 | |
| | | I _{OL} = 50 mA† | 5.5 V | | | | 1.65 | | | |
| I _{OL} = 75 mA† | 5.5 V | | | | | | 1.65 | | | |
| I _I | V _I = V _{CC} or GND | | 5.5 V | | ±0.1 | | ±1 | | ±1 | μA |
| I _{CC} | V _I = V _{CC} or GND, I _O = 0 | | 5.5 V | | 4 | | 80 | | 40 | μA |
| C _i | | | | | 10 | | 10 | | 10 | pF |

† Test one output at a time, not exceeding 1-second duration. Measurement is made by forcing indicated current and measuring voltage to minimize power dissipation. Test verifies a minimum 50-Ω transmission-line drive capability at 85°C and 75-Ω transmission-line drive capability at 125°C.

timing requirements over recommended operating free-air temperature range, V_{CC} = 1.5 V (unless otherwise noted)

| | | -55°C to 125°C | | -40°C to 85°C | | UNIT |
|--------------------|----------------------------|-----------------|-----|---------------|-----|------|
| | | MIN | MAX | MIN | MAX | |
| f _{clock} | Clock frequency | | 8 | | 9 | MHz |
| t _w | Pulse duration | CLK high or low | | 63 | 55 | ns |
| | | CLR or PRE low | | 56 | 49 | |
| t _{su} | Setup time, before CLK↑ | J or K̄ | | 69 | 61 | ns |
| t _h | Hold time, after CLK↑ | J or K̄ | | 0 | 0 | ns |
| t _{rec} | Recovery time, before CLK↑ | CLR↑ or PRE↑ | | 31 | 27 | ns |



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DUAL J-K POSITIVE-EDGE-TRIGGERED FLIP-FLOPS
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timing requirements over recommended operating free-air temperature range, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted)

| | | | -55°C to 125°C | | -40°C to 85°C | | UNIT |
|--------------------|--------------------------------------|--|----------------|-----|---------------|-----|------|
| | | | MIN | MAX | MIN | MAX | |
| f_{clock} | Clock frequency | | 71 | | 81 | | MHz |
| t_w | Pulse duration | CLK high or low | 7 | | 6 | | ns |
| | | $\overline{\text{CLR}}$ or $\overline{\text{PRE}}$ | 6.3 | | 5.5 | | |
| t_{su} | Setup time, before CLK \uparrow | J or $\overline{\text{K}}$ | 7.7 | | 6.8 | | ns |
| t_h | Hold time, after CLK \uparrow | J or $\overline{\text{K}}$ | 0 | | 0 | | ns |
| t_{rec} | Recovery time, before CLK \uparrow | $\overline{\text{CLR}}\uparrow$ or $\overline{\text{PRE}}\uparrow$ | 3.5 | | 3.1 | | ns |

timing requirements over recommended operating free-air temperature range, $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted)

| | | | -55°C to 125°C | | -40°C to 85°C | | UNIT |
|--------------------|--------------------------------------|--|----------------|-----|---------------|-----|------|
| | | | MIN | MAX | MIN | MAX | |
| f_{clock} | Clock frequency | | 100 | | 114 | | MHz |
| t_w | Pulse duration | CLK high or low | 5 | | 4.4 | | ns |
| | | $\overline{\text{CLR}}$ or $\overline{\text{PRE}}$ | 4.5 | | 3.9 | | |
| t_{su} | Setup time, before CLK \uparrow | J or $\overline{\text{K}}$ | 5.5 | | 4.8 | | ns |
| t_h | Hold time, after CLK \uparrow | J or $\overline{\text{K}}$ | 0 | | 0 | | ns |
| t_{rec} | Recovery time, before CLK \uparrow | $\overline{\text{CLR}}\uparrow$ or $\overline{\text{PRE}}\uparrow$ | 2.5 | | 2.2 | | ns |

switching characteristics over recommended operating free-air temperature range, $V_{CC} = 1.5\text{ V}$, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | -55°C to 125°C | | -40°C to 85°C | | UNIT |
|------------------|--|----------------------------|----------------|-----|---------------|-----|------|
| | | | MIN | MAX | MIN | MAX | |
| f_{max} | | | 8 | | 9 | | MHz |
| t_{PLH} | CLK | Q or $\overline{\text{Q}}$ | | 129 | | 117 | ns |
| | $\overline{\text{CLR}}$ or $\overline{\text{PRE}}$ | | | 153 | | 139 | |
| t_{PHL} | CLK | Q or $\overline{\text{Q}}$ | | 129 | | 117 | ns |
| | $\overline{\text{CLR}}$ or $\overline{\text{PRE}}$ | | | 153 | | 139 | |

switching characteristics over recommended operating free-air temperature range, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | -55°C to 125°C | | -40°C to 85°C | | UNIT |
|------------------|--|----------------------------|----------------|------|---------------|------|------|
| | | | MIN | MAX | MIN | MAX | |
| f_{max} | | | 71 | | 81 | | MHz |
| t_{PLH} | CLK | Q or $\overline{\text{Q}}$ | 3.6 | 14.4 | 3.7 | 13.1 | ns |
| | $\overline{\text{CLR}}$ or $\overline{\text{PRE}}$ | | 4.3 | 17.1 | 4.4 | 15.5 | |
| t_{PHL} | CLK | Q or $\overline{\text{Q}}$ | 3.6 | 14.4 | 3.7 | 13.1 | ns |
| | $\overline{\text{CLR}}$ or $\overline{\text{PRE}}$ | | 4.3 | 17.1 | 4.4 | 15.5 | |

CD54AC109, CD74AC109
DUAL J-K POSITIVE-EDGE-TRIGGERED FLIP-FLOPS
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switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | -55°C to 125°C | | -40°C to 85°C | | UNIT |
|-----------|--|----------------|-------------------|------|------------------|------|------|
| | | | MIN | MAX | MIN | MAX | |
| f_{max} | | | 100 | | 114 | | MHz |
| t_{PLH} | CLK | Q or \bar{Q} | 2.6 | 10.3 | 2.7 | 9.4 | ns |
| | $\overline{\text{CLR}}$ or $\overline{\text{PRE}}$ | | 3.1 | 12.2 | 3.2 | 11.1 | |
| t_{PHL} | CLK | Q or \bar{Q} | 2.6 | 10.3 | 2.7 | 9.4 | ns |
| | $\overline{\text{CLR}}$ or $\overline{\text{PRE}}$ | | 3.1 | 12.2 | 3.2 | 11.1 | |

operating characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

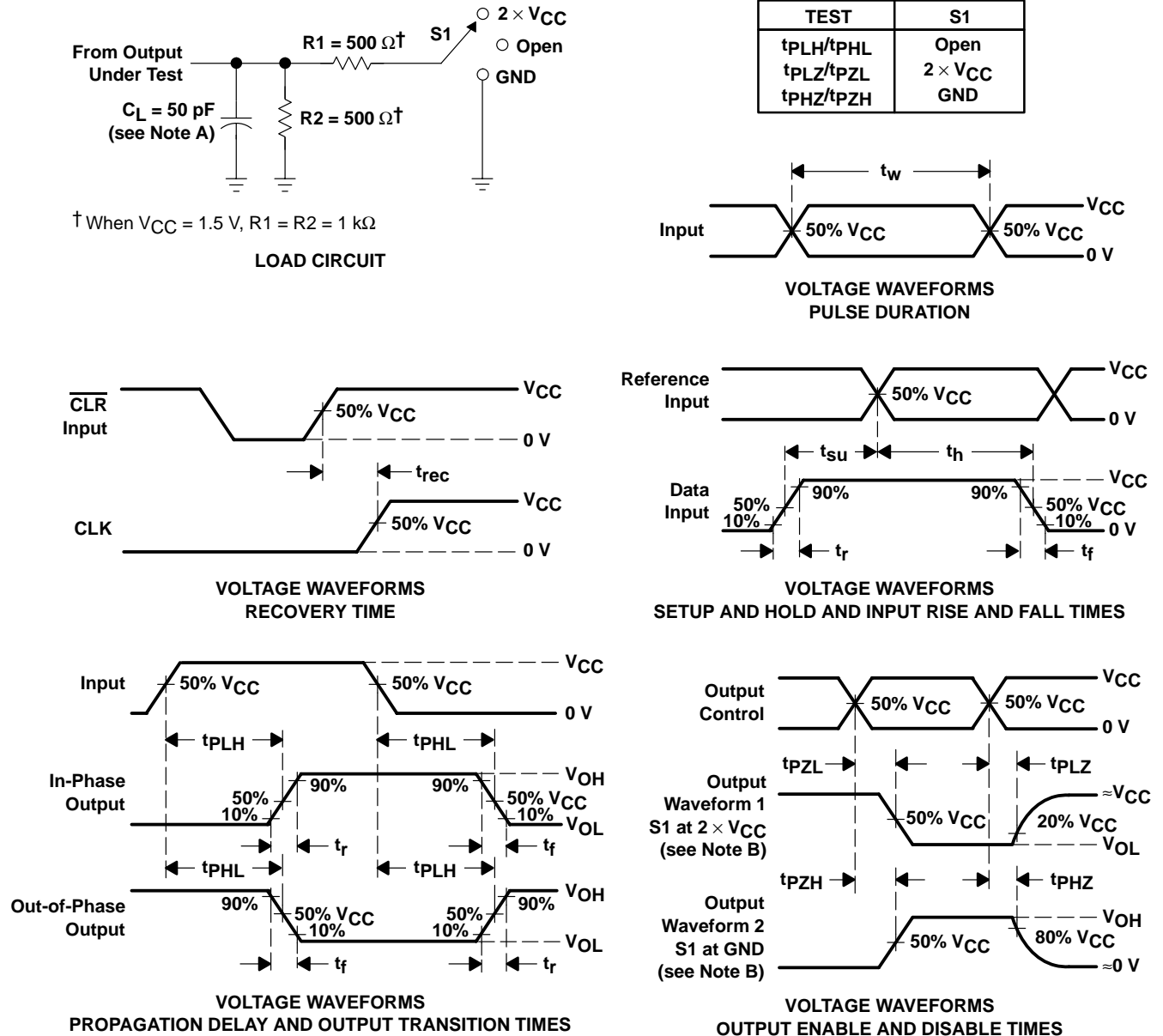
| PARAMETER | | TYP | UNIT |
|-----------|-------------------------------|-----|------|
| C_{pd} | Power dissipation capacitance | 56 | pF |



CD54AC109, CD74AC109 DUAL J-K POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH CLEAR AND PRESET

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PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A. C_L includes probe and test-fixture capacitance.
 - B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
 - C. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r = 3\text{ ns}$, $t_f = 3\text{ ns}$. Phase relationships between waveforms are arbitrary.
 - D. For clock inputs, f_{max} is measured with the input duty cycle at 50%.
 - E. The outputs are measured one at a time with one input transition per measurement.
 - F. t_{PLH} and t_{PHL} are the same as t_{pd} .
 - G. t_{PZL} and t_{PZH} are the same as t_{en} .
 - H. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - I. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|---------------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| CD54AC109F3A | ACTIVE | CDIP | J | 16 | 25 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | CD54AC109F3A | Samples |
| CD74AC109E | ACTIVE | PDIP | N | 16 | 25 | RoHS & Green | NIPDAU | N / A for Pkg Type | -55 to 125 | CD74AC109E | Samples |
| CD74AC109M96 | ACTIVE | SOIC | D | 16 | 2500 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -55 to 125 | AC109M | Samples |

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF CD54AC109, CD74AC109 :

- Catalog : [CD74AC109](#)
- Military : [CD54AC109](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD74AC109M96 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD74AC109M96 | SOIC | D | 16 | 2500 | 340.5 | 336.1 | 32.0 |

TUBE


*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| CD74AC109E | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| CD74AC109E | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 -  C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 -  D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---------------|------------------------|------------------------|------------------------|------------------------|
| A | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC |
| B MAX | 0.785 (19,94) | .840 (21,34) | 0.960 (24,38) | 1.060 (26,92) |
| B MIN | — | — | — | — |
| C MAX | 0.300 (7,62) | 0.300 (7,62) | 0.310 (7,87) | 0.300 (7,62) |
| C MIN | 0.245 (6,22) | 0.245 (6,22) | 0.220 (5,59) | 0.245 (6,22) |



4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package is hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



4040049/E 12/2002

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - The 20 pin end lead shoulder width is a vendor option, either half or full width.

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