

# SN54F109, SN74F109 DUAL J-K POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH CLEAR AND PRESET

SDFS047A – MARCH 1987 – REVISED OCTOBER 1993

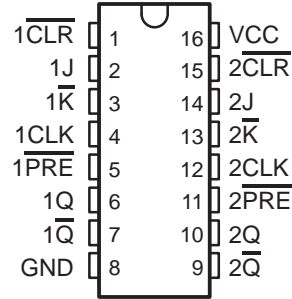
- Package Options Include Plastic Small-Outline Packages, Ceramic Chip Carriers, and Standard Plastic and Ceramic 300-mil DIPs

## description

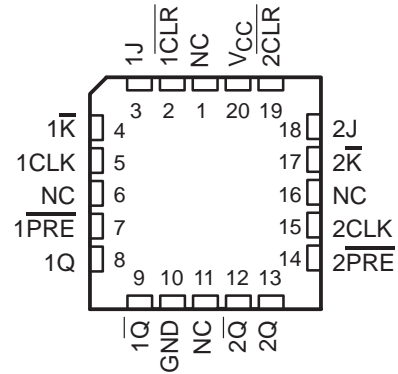
These devices contain two independent J-K positive-edge-triggered flip-flops. A low level at the preset (PRE) or clear (CLR) inputs sets or resets the outputs regardless of the levels of the other inputs. When PRE and CLR are inactive (high), data at the J and K input meeting the setup-time requirements are transferred to the outputs on the positive-going edge of the clock 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 K inputs may be changed without affecting the levels at the outputs. These versatile flip-flops can perform as toggle flip-flops by grounding K and tying J high. They also can perform as D-type flip-flops if J and K are tied together.

The SN54F109 is characterized for operation over the full military temperature range of -55°C to 125°C. The SN74F109 is characterized for operation from 0°C to 70°C.

**SN54F109 . . . J PACKAGE  
SN74F109 . . . D OR N PACKAGE  
(TOP VIEW)**



**SN54F109 . . . FK PACKAGE  
(TOP VIEW)**



NC – No internal connection

**FUNCTION TABLE**

| INPUTS |     |     |   |   | OUTPUTS        |                     |
|--------|-----|-----|---|---|----------------|---------------------|
| PRE    | CLR | CLK | J | K | Q              | Q-bar               |
| 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 <sub>0</sub> | Q <sub>0</sub> -bar |
| H      | H   | ↑   | H | H | H              | L                   |
| H      | H   | L   | X | X | Q <sub>0</sub> | Q <sub>0</sub> -bar |

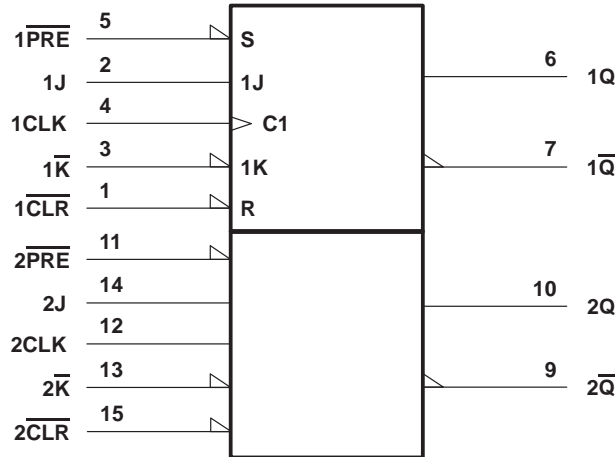
† The output levels are not guaranteed to meet the minimum levels for V<sub>OH</sub>. Furthermore, this configuration is nonstable; that is, it will not persist when PRE or CLR returns to its inactive (high) level.

# SN54F109, SN74F109

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

SDFS047A – MARCH 1987 – REVISED OCTOBER 1993

### logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for the D, J, and N packages.

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

|   |                    |
|---|--------------------|
| Supply voltage range, $V_{CC}$                        | –0.5 V to 7 V      |
| Input voltage range, $V_I$ (see Note 1)               | –1.2 V to 7 V      |
| Input current range                                   | –30 mA to 5 mA     |
| Voltage range applied to any output in the high state | –0.5 V to $V_{CC}$ |
| Current into any output in the low state              | 40 mA              |
| Operating free-air temperature range: SN54F109        | –55°C to 125°C     |
| SN74F109  | 0°C to 70°C        |
| Storage temperature range                             | –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.

NOTE 1: The input voltage ratings may be exceeded provided the input current ratings are observed.

### recommended operating conditions

|                                      | SN54F109 |     |     | SN74F109 |     |     | UNIT |
|--------------------------------------|----------|-----|-----|----------|-----|-----|------|
|                                      | MIN      | NOM | MAX | MIN      | NOM | MAX |      |
| $V_{CC}$ Supply voltage              | 4.5      | 5   | 5.5 | 4.5      | 5   | 5.5 | V    |
| $V_{IH}$ High-level input voltage    | 2        |     |     | 2        |     |     | V    |
| $V_{IL}$ Low-level input voltage     |          |     | 0.8 |          |     | 0.8 | V    |
| $I_{IK}$ Input clamp current         |          |     | –18 |          |     | –18 | mA   |
| $I_{OH}$ High-level output current   |          |     | –1  |          |     | –1  | mA   |
| $I_{OL}$ Low-level output current    |          |     | 20  |          |     | 20  | mA   |
| $T_A$ Operating free-air temperature | –55      |     | 125 | 0        |     | 70  | °C   |

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

| PARAMETER         | TEST CONDITIONS                                       | SN54F109  |      |     | SN74F109 |      |     | UNIT          |
|-------------------|---|---|------|-----|----------|------|-----|---------------|
|                   |   | MIN   | TYP† | MAX | MIN      | TYP† | MAX |               |
| $V_{IK}$          | $V_{CC} = 4.5\text{ V}$ ,<br>$I_I = -18\text{ mA}$    | -1.2  |      |     | -1.2     |      |     | V             |
| $V_{OH}$          | $V_{CC} = 4.5\text{ V}$ ,<br>$I_{OH} = -1\text{ mA}$  | 2.5   | 3.4  |     | 2.5      | 3.4  |     | V             |
|                   | $V_{CC} = 4.75\text{ V}$ ,<br>$I_{OH} = -1\text{ mA}$ | 2.7   |      |     |          |      |     |               |
| $V_{OL}$          | $V_{CC} = 4.5\text{ V}$ ,<br>$I_{OL} = 20\text{ mA}$  | 0.3 0.5   |      |     | 0.3 0.5  |      |     | V             |
| $I_I$             | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 7\text{ V}$       | 0.1   |      |     | 0.1      |      |     | mA            |
| $I_{IH}$          | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 2.7\text{ V}$     | 20  |      |     | 20       |      |     | $\mu\text{A}$ |
| $I_{IL}$          | J, $\bar{K}$ , CLK                                    | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 0.5\text{ V}$ |      |     | -0.6     |      |     | mA            |
|                   | $\overline{\text{PRE}}$ or $\overline{\text{CLR}}$    |   |      |     | -1.8     |      |     |               |
| $I_{OS}^\ddagger$ | $V_{CC} = 5.5\text{ V}$ ,<br>$V_O = 0$                | -60   | -150 |     | -60      | -150 |     | mA            |
| $I_{CC}$          | $V_{CC} = 5.5\text{ V}$ ,<br>See Note 2               | 11.7  | 17   |     | 11.7     | 17   |     | mA            |

† All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

‡ Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.

NOTE 2:  $I_{CC}$  is measured with J,  $\bar{K}$ , CLK, and  $\overline{\text{PRE}}$  grounded then with J,  $\bar{K}$ , CLK, and  $\overline{\text{CLR}}$  grounded.

**timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)**

|                    |  | $V_{CC} = 5\text{ V}$ ,<br>$T_A = 25^\circ\text{C}$              |     | SN54F109 |     | SN74F109 |     | UNIT |
|--------------------|--|--|-----|----------|-----|----------|-----|------|
|                    |  | 'F74   |     |          |     |          |     |      |
|                    |  | MIN  | MAX | MIN      | MAX | MIN      | MAX |      |
| $f_{\text{clock}}$ | Clock frequency                                    | 0  | 100 | 0        | 70  | 0        | 90  | MHz  |
| $t_w$              | Pulse duration                                     | CLK high, $\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ low |     | 4        | 4   | 4        | 4   | ns   |
|                    |  | CLK low  |     | 5        | 5   | 5        | 5   |      |
| $t_{\text{su}}$    | Setup time, data before CLK $\uparrow$             | High   |     | 3        | 3   | 3        | 3   | ns   |
|                    |  | Low  |     | 3        | 3   | 3        | 3   |      |
|                    | Setup time, inactive-state before CLK $\uparrow$ § | $\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ to CLK        |     | 2        | 2   | 2        | 2   |      |
| $t_h$              | Hold time, data after CLK $\uparrow$               | High   |     | 1        | 1   | 1        | 1   | ns   |
|                    |  | Low  |     | 1        | 1   | 1        | 1   |      |

§ Inactive-state setup time is also referred to as recovery time.

**switching characteristics (see Note 3)**

| PARAMETER        | FROM (INPUT)                                       | TO (OUTPUT)    | $V_{CC} = 5\text{ V}$ ,<br>$C_L = 50\text{ pF}$ ,<br>$R_L = 500\ \Omega$ ,<br>$T_A = 25^\circ\text{C}$ |     |     | $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$ ,<br>$C_L = 50\text{ pF}$ ,<br>$R_L = 500\ \Omega$ ,<br>$T_A = \text{MIN to MAX}^\ddagger$ |      |          |      | UNIT |
|------------------|--|----------------|--|-----|-----|---|------|----------|------|------|
|                  |  |                | 'F109  |     |     | SN54F109  |      | SN74F109 |      |      |
|                  |  |                | MIN  | TYP | MAX | MIN   | MAX  | MIN      | MAX  |      |
| $f_{\text{max}}$ |  |                | 100  | 150 |     | 70  |      | 90       | MHz  |      |
| $t_{\text{PLH}}$ | CLK  | Q or $\bar{Q}$ | 3  | 4.9 | 7   | 3   | 9    | 3        | 8    | ns   |
| $t_{\text{PHL}}$ |  |                | 3.6  | 5.8 | 8   | 3.6   | 10.5 | 3.6      | 9.2  |      |
| $t_{\text{PLH}}$ | $\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ | Q or $\bar{Q}$ | 2.4  | 4.8 | 7   | 2.4   | 9    | 2.4      | 8    | ns   |
| $t_{\text{PHL}}$ |  |                | 2.7  | 6.6 | 9   | 2.7   | 11.5 | 2.7      | 10.5 |      |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

NOTE 3: Load circuits and waveforms are shown in Section 1.



**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup>    | Lead/<br>Ball Finish | MSL Peak Temp <sup>(3)</sup> | Samples<br>(Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|----------------------------|----------------------|------------------------------|-----------------------------|
| 5962-9758001Q2A  | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                        | Call TI              | Call TI                      |                             |
| 5962-9758001QEA  | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                        | Call TI              | Call TI                      |                             |
| 5962-9758001QFA  | ACTIVE                | CFP          | W               | 16   | 1           | TBD                        | Call TI              | Call TI                      |                             |
| JM38510/34102B2A | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                        | POST-PLATE           | N / A for Pkg Type           |                             |
| JM38510/34102BEA | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                        | A42                  | N / A for Pkg Type           |                             |
| JM38510/34102BFA | ACTIVE                | CFP          | W               | 16   | 1           | TBD                        | A42                  | N / A for Pkg Type           |                             |
| M38510/34102B2A  | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                        | POST-PLATE           | N / A for Pkg Type           |                             |
| M38510/34102BEA  | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                        | A42                  | N / A for Pkg Type           |                             |
| M38510/34102BFA  | ACTIVE                | CFP          | W               | 16   | 1           | TBD                        | A42                  | N / A for Pkg Type           |                             |
| SN74F109D        | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN74F109DE4      | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN74F109DG4      | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN74F109DR       | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN74F109DRE4     | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN74F109DRG4     | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| SN74F109N        | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| SN74F109NE4      | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)             | CU NIPDAU            | N / A for Pkg Type           |                             |
| SNJ54F109FK      | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                        | POST-PLATE           | N / A for Pkg Type           |                             |
| SNJ54F109J       | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                        | A42                  | N / A for Pkg Type           |                             |
| SNJ54F109W       | ACTIVE                | CFP          | W               | 16   | 1           | TBD                        | A42                  | N / A for Pkg Type           |                             |

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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**OTHER QUALIFIED VERSIONS OF SN54F109, SN74F109 :**

● Catalog: [SN74F109](#)

● Military: [SN54F109](#)

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 |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74F109DR | 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) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74F109DR | SOIC         | D               | 16   | 2500 | 333.2       | 345.9      | 28.6        |

J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



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



4040083/F 03/03

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



W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



4040180-3/D 07/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only.
  - E. Falls within MIL STD 1835 GDFP1-F16 and JEDEC MO-092AC

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



| NO. OF TERMINALS ** | A                |                  | B                |                  |
|---------------------|------------------|------------------|------------------|------------------|
|                     | MIN              | MAX              | MIN              | MAX              |
| 20                  | 0.342<br>(8,69)  | 0.358<br>(9,09)  | 0.307<br>(7,80)  | 0.358<br>(9,09)  |
| 28                  | 0.442<br>(11,23) | 0.458<br>(11,63) | 0.406<br>(10,31) | 0.458<br>(11,63) |
| 44                  | 0.640<br>(16,26) | 0.660<br>(16,76) | 0.495<br>(12,58) | 0.560<br>(14,22) |
| 52                  | 0.740<br>(18,78) | 0.761<br>(19,32) | 0.495<br>(12,58) | 0.560<br>(14,22) |
| 68                  | 0.938<br>(23,83) | 0.962<br>(24,43) | 0.850<br>(21,6)  | 0.858<br>(21,8)  |
| 84                  | 1.141<br>(28,99) | 1.165<br>(29,59) | 1.047<br>(26,6)  | 1.063<br>(27,0)  |



4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - Falls within JEDEC MS-004

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



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

4040049/E 12/2002

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- 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.

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| Amplifiers             | <a href="http://amplifier.ti.com">amplifier.ti.com</a>                               |
| Data Converters        | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>                       |
| DLP® Products          | <a href="http://www.dlp.com">www.dlp.com</a>   |
| DSP                    | <a href="http://dsp.ti.com">dsp.ti.com</a>   |
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| RFID                   | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>                                 |
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