# TYPES SN54LS114A, SN54S114, SN74LS114A, SN74S114
# DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESET, COMMON CLEAR, AND COMMON CLOCK

REVISED DECEMBER 1983

- **Fully Buffered to Offer Maximum Isolation from External Disturbance**
- **Package Options Include Both Plastic and Ceramic Carriers in Addition to Plastic and Ceramic DIPs.**
- **Dependable Texas Instruments Quality and Reliability**

## description

These devices contain two independent J-K negative-edge-triggered flip-flops. A low level at the preset and clear inputs sets or resets the outputs regardless of the levels of the other inputs. When preset and clear are inactive (high), data at the J and K inputs meeting the setup time requirements are transferred to the outputs on the negative-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 tying J and K high.

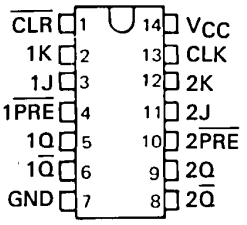
The SN54LS114A and SN54S114 are characterized for operation over the full military temperature range of −55°C to 125°C. The SN74LS114A and SN74S114 are characterized for operation from 0°C to 70°C.

FUNCTION TABLE

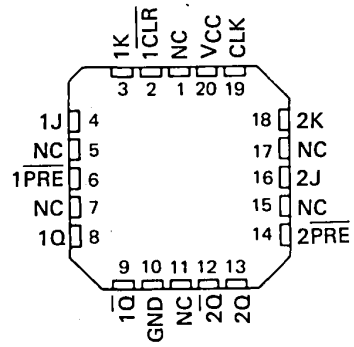
| INPUTS | | | | | OUTPUTS | |
|---|---|---|---|---|---|---|
| $\overline{PRE}$ | $\overline{CLR}$ | CLK | J | K | Q | $\overline{Q}$ |
| L | H | X | X | X | H | L |
| H | L | X | X | X | L | H |
| L | L | X | X | X | H† | H† |
| H | H | ↓ | L | L | $Q_0$ | $\overline{Q}_0$ |
| H | H | ↓ | H | L | H | L |
| H | H | ↓ | L | H | L | H |
| H | H | ↓ | H | H | TOGGLE | |
| H | H | H | X | X | $Q_0$ | $\overline{Q}_0$ |

† The output levels in this configuration are not guaranteed to meet the minimum levels for $V_{OH}$ if the lows at preset and clear are near $V_{IL}$ minimum. Furthermore, this configuration is nonstable; that is, it will not persist when either preset or clear returns to its inactive (high) level.

SN54LS114A, SN54S114 . . . J OR W PACKAGE
SN74LS114A, SN74S114 . . . D, J OR N PACKAGE
(TOP VIEW)

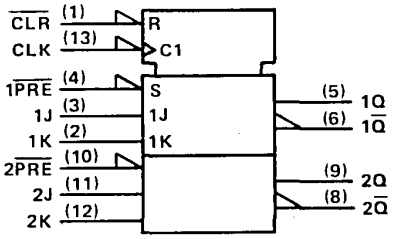



SN54LS114A, SN54S114 . . . FK PACKAGE
SN74LS114A, SN74S114 . . . FN PACKAGE
(TOP VIEW)




NC - No internal connection

## logic symbol




Pin numbers shown on logic notation are for D, J or N packages.

3 TTL DEVICES



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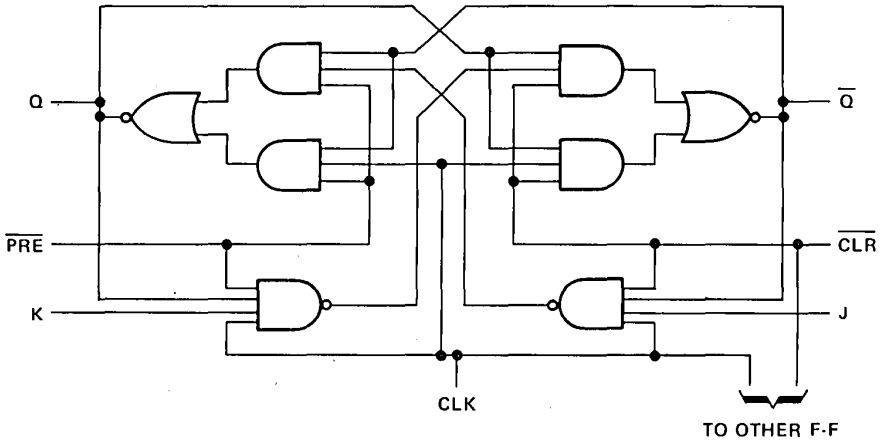
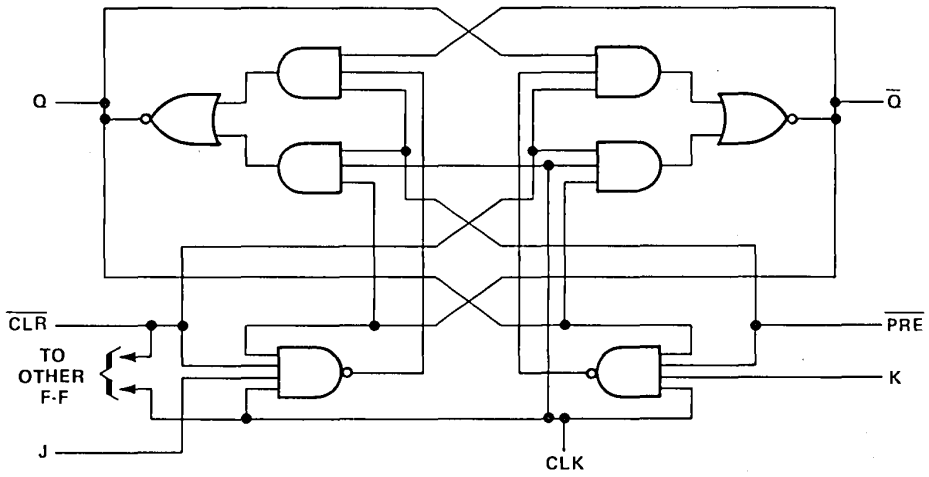
**logic diagram**

'LS114A




'S114





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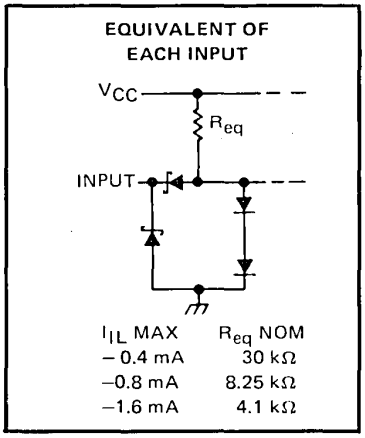
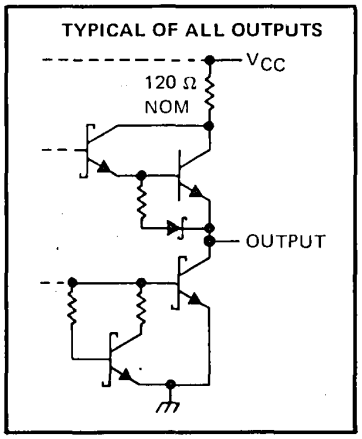
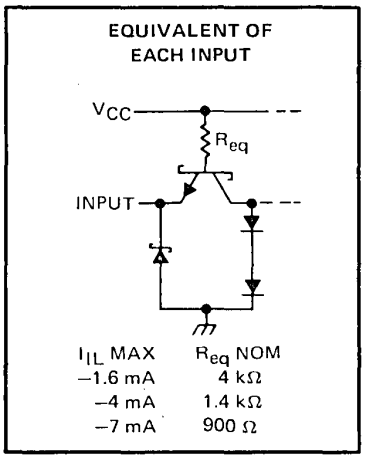
## schematics of inputs and outputs

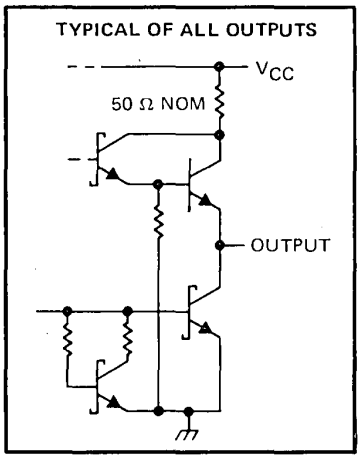
'LS114A




'S114






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

Supply voltage, $V_{CC}$ (see Note 1) . . . . . 7 V
Input voltage: 'LS114A . . . . . 7 V
'S114 . . . . . 5.5 V
Operating free-air temperature range: SN54' . . . . . −55°C to 125°C
SN74' . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

## recommended operating conditions

| | | | SN54LS114A | | | SN74LS114A | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | NOM | MAX | MIN | NOM | MAX | |
| $V_{CC}$ | Supply voltage | | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| $V_{IH}$ | High-level input voltage | | 2 | | | 2 | | | V |
| $V_{IL}$ | Low-level input voltage | | | | 0.7 | | | 0.8 | V |
| $I_{OH}$ | High-level output current | | | | −0.4 | | | −0.4 | mA |
| $I_{OL}$ | Low-level output current | | | | 4 | | | 8 | mA |
| $f_{clock}$ | Clock frequency | | 0 | | 30 | 0 | | 30 | MHz |
| $t_w$ | Pulse duration | CLK | 20 | | | 20 | | | ns |
| | | $\overline{PRE}$ or $\overline{CLR}$ low | 25 | | | 25 | | | |
| $t_{su}$ | Set up time-before CLK↓ | data high or low | 20 | | | 20 | | | ns |
| | | $\overline{CLR}$ inactive | 25 | | | 25 | | | |
| | | $\overline{PRE}$ inactive | 20 | | | 20 | | | |
| $t_h$ | Hold time-data after CLK↓ | | 0 | | | 0 | | | ns |
| $T_A$ | Operating free-air temperature | | −55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | | TEST CONDITIONS† | | | SN54LS114A | | | SN74LS114A | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| $V_{IK}$ | | $V_{CC}$ = MIN, | $I_I$ = −18 mA | | | | −1.5 | | | −1.5 | V |
| $V_{OH}$ | | $V_{CC}$ = MIN, $I_{OH}$ = −0.4 mA | $V_{IH}$ = 2 V, | $V_{IL}$ = MAX, | 2.5 | 3.4 | | 2.7 | 3.4 | | V |
| $V_{OL}$ | | $V_{CC}$ = MIN, $I_{OL}$ = 4 mA | $V_{IL}$ = MAX, | $V_{IH}$ = 2 V, | | 0.25 | 0.4 | | 0.25 | 0.4 | V |
| | | $V_{CC}$ = MIN, $I_{OL}$ = 8 mA | $V_{IL}$ = MAX, | $V_{IH}$ = 2 V, | | | | | 0.35 | 0.5 | |
| $I_I$ | J or K | $V_{CC}$ = MAX, | $V_I$ = 7 V | | | | 0.1 | | | 0.1 | mA |
| | $\overline{CLR}$ | | | | | | 0.6 | | | 0.6 | |
| | $\overline{PRE}$ | | | | | | 0.3 | | | 0.3 | |
| | CLK | | | | | | 0.8 | | | 0.8 | |
| $I_{IH}$ | J or K | $V_{CC}$ = MAX, | $V_I$ = 2.7 V | | | | 20 | | | 20 | μA |
| | $\overline{CLR}$ | | | | | | 120 | | | 120 | |
| | $\overline{PRE}$ | | | | | | 60 | | | 60 | |
| | CLK | | | | | | 160 | | | 160 | |
| $I_{IL}$ | J or K | $V_{CC}$ = MAX, | $V_I$ = 0.4 V | | | | −0.4 | | | −0.4 | mA |
| | $\overline{CLR}$ | | | | | | −1.6 | | | −1.6 | |
| | $\overline{PRE}$ | | | | | | −0.8 | | | −0.8 | |
| | CLK | | | | | | −1.6 | | | −1.6 | |
| $I_{OS}$§ | | $V_{CC}$ = MAX, | see Note 4 | | −20 | | −100 | −20 | | −100 | mA |
| $I_{CC}$ | | $V_{CC}$ = MAX, | see Note 2 | | | 4 | 6 | | 4 | 6 | mA |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°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: With all outputs open, $I_{CC}$ is measured with the Q and $\overline{Q}$ outputs high in turn. At the time of measurement, the clock input is grounded.
NOTE 4: For certain devices where state commutation can be caused by shorting an output to ground, an equivalent test may be performed with $V_O$ = 2.25 V and 2.125 V for the '54 family and the '74 family, respectively, with the minimum and maximum limits reduced to one half of their stated values.





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**switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C (see note 3)**

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $f_{max}$ | | | $R_L$ = 2 kΩ, $C_L$ = 15 pF | 30 | 45 | | MHz |
| $t_{PLH}$ | $\overline{CLR}$, $\overline{PRE}$ or CLK | Q or $\overline{Q}$ | | | 15 | 20 | ns |
| $t_{PHL}$ | | | | | 15 | 20 | ns |

NOTE 3: See General Information Section for load circuits and voltage waveforms.

## recommended operating conditions

| | | | SN54S114 | | | SN74S114 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | NOM | MAX | MIN | NOM | MAX | |
| $V_{CC}$ | Supply voltage | | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| $V_{IH}$ | High-level input voltage | | 2 | | | 2 | | | V |
| $V_{IL}$ | Low-level input voltage | | | | 0.8 | | | 0.8 | V |
| $I_{OH}$ | High-level output current | | | | −1 | | | −1 | mA |
| $I_{OL}$ | Low-level output current | | | | 20 | | | 20 | mA |
| $t_w$ | Pulse duration | CLK high | 6 | | | 6 | | | ns |
| | | CLK low | 6.5 | | | 6.5 | | | |
| | | $\overline{CLR}$ or $\overline{PRE}$ low | 8 | | | 8 | | | |
| $t_{su}$ | Setup time | data high or low | 3 | | | 3 | | | ns |
| $t_h$ | Hold time-data after CLK↓ | | 0 | | | 0 | | | ns |
| $T_A$ | Operating free-air temperature | | −55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | | TEST CONDITIONS† | | | SN54S114 | | | SN74S114 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| $V_{IK}$ | | $V_{CC}$ = MIN, | $I_I$ = −18 mA | | | | −1.2 | | | −1.2 | V |
| $V_{OH}$ | | $V_{CC}$ = MIN, $I_{OH}$ = −1 mA | $V_{IH}$ = 2 V, | $V_{IL}$ = 0.8 V, | 2.5 | 3.4 | | 2.7 | 3.4 | | V |
| $V_{OL}$ | | $V_{CC}$ = MIN, $I_{OL}$ = 20 mA | $V_{IH}$ = 2 V, | $V_{IL}$ = 0.8 V, | | | 0.5 | | | 0.5 | V |
| $I_I$ | | $V_{CC}$ = MAX, | $V_I$ = 5.5 V | | | | 1 | | | 1 | mA |
| $I_{IH}$ | J or K | $V_{CC}$ = MAX, | $V_I$ = 2.7 V | | | | 50 | | | 50 | μA |
| | $\overline{CLR}$ | | | | | | 200 | | | 200 | |
| | $\overline{PRE}$ | | | | | | 100 | | | 100 | |
| | CLK | | | | | | 200 | | | 200 | |
| $I_{IL}$ | J or K | $V_{CC}$ = MAX, | $V_I$ = 0.5 V | | | | −1.6 | | | −1.6 | mA |
| | $\overline{CLR}$ | | | | | | −14 | | | −14 | |
| | $\overline{PRE}$ | | | | | | −7 | | | −7 | |
| | CLK | | | | | | −8 | | | −8 | |
| $I_{OS}$§ | | $V_{CC}$ = MAX | | | −40 | | −100 | −40 | | −100 | mA |
| $I_{CC}$ | | $V_{CC}$ = MAX, | see Note 2 | | | 15 | 25 | | 15 | 25 | mA |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°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: With all outputs open, $I_{CC}$ is measured with the Q and $\overline{Q}$ outputs high in turn. At the time of measurement, the clock input is grounded.

## switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C (see note 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $f_{max}$ | | | $R_L$ = 280 Ω, $C_L$ = 15 pF | 80 | 125 | | MHz |
| $t_{PLH}$ | $\overline{PRE}$ or $\overline{CLR}$ | Q or $\overline{Q}$ | | | 4 | 7 | ns |
| $t_{PHL}$ | $\overline{PRE}$ or $\overline{CLR}$ (CLK high) | $\overline{Q}$ or Q | | | 5 | 7 | ns |
| | $\overline{PRE}$ or $\overline{CLR}$ (CLK low) | | | | 5 | 7 | |
| $t_{PLH}$ | CLK | Q or $\overline{Q}$ | | | 4 | 7 | ns |
| $t_{PHL}$ | | | | | 5 | 7 | ns |

NOTE 3: See General Information Section for load circuits and voltage waveforms.



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