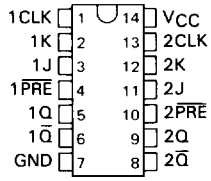
D2661, APRIL 1982—REVISED DECEMBER 1983

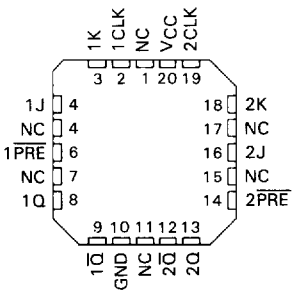
- **Fully Buffered to Offer Maximum Isolation from External Disturbance**
- **Package Options Include Both Plastic and Ceramic Carriers in Addition to Plastic and Ceramic DIPs.**
- **Dependable Texas Instruments Quality and Reliability**

| TYPE | TYPICAL MAXIMUM CLOCK FREQUENCY | TYPICAL POWER DISSIPATION PER FLIP-FLOP |
|---|---|---|
| 'ALS113A | 40 MHz ($C_L$ = 15 pF) | 6 mW |
| 'AS113 | 175 MHz ($C_L$ = 50 pF) | 95 mW |

**SN54ALS113A, SN54AS113 . . . J PACKAGE**
**SN74ALS113A, SN74AS113 . . . N PACKAGE**
**(TOP VIEW)**




**SN54ALS113A, SN54AS113 . . . FH PACKAGE**
**SN74ALS113A, SN74AS113 . . . FN PACKAGE**
**(TOP VIEW)**




NC — No internal connection

## description

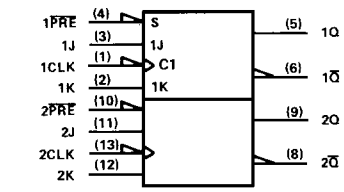
These devices contain two independent J-K negative-edge-triggered flip-flops. A low level at the Preset input sets the outputs regardless of the levels of the other inputs. When Preset ($\overline{PRE}$) is inactive (high), data at the J and K inputs meeting the setup time requirements are transferred 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 SN54ALS113A and SN54AS113 are characterized for operation over the full military temperature range of −55°C to 125°C. The SN74ALS113A and SN74AS113 are characterized for operation from 0°C to 70°C.

**FUNCTION TABLE**

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

## logic symbol




Pin numbers shown are for J and N packages.

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

Supply voltage, $V_{CC}$ . . . . . 7 V
Input voltage . . . . . 7 V
Operating free-air temperature range: SN54ALS113A, SN54AS113 . . . . . −55°C to 125°C
SN74ALS113A, SN74AS113 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

### recommended operating conditions

| | | | SN54ALS113A | | | SN74ALS113A | | | 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 |
| $I_{OH}$ | High-level output current | | | | −0.4 | | | −0.4 | mA |
| $I_{OL}$ | Low-level output current | | | | 4 | | | 8 | mA |
| $f_{clock}$ | Clock frequency | | 0 | | 25 | 0 | | 30 | MHz |
| $t_w$ | Pulse duration | $\overline{PRE}$ low | 15 | | | 10 | | | ns |
| | | CLK high | 20 | | | 16.5 | | | |
| | | CLK low | 20 | | | 16.5 | | | |
| $t_{su}$ | Setup time before CLK↓ | Data | 25 | | | 22 | | | ns |
| | | $\overline{PRE}$ inactive | 22 | | | 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 | | SN54ALS113A | | | SN74ALS113A | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP† | MAX | MIN | TYP† | MAX | |
| $V_{IK}$ | | $V_{CC}$ = 4.5 V, | $I_I$ = −18 mA | | | −1.5 | | | −1.5 | V |
| $V_{OH}$ | | $V_{CC}$ = 4.5 V to 5.5 V, | $I_{OH}$ = −0.4 mA | $V_{CC}$−2 | | | $V_{CC}$−2 | | | V |
| $V_{OL}$ | | $V_{CC}$ = 4.5 V, | $I_{OL}$ = 4 mA | | 0.25 | 0.4 | | 0.25 | 0.4 | V |
| | | $V_{CC}$ = 4.5 V, | $I_{OL}$ = 8 mA | | | | | 0.35 | 0.5 | |
| $I_I$ | J, K, or CLK | $V_{CC}$ = 5.5 V, | $V_I$ = 7 V | | | 0.1 | | | 0.1 | mA |
| | $\overline{PRE}$ | | | | | 0.2 | | | 0.2 | |
| $I_{IH}$ | J, K, or CLK | $V_{CC}$ = 5.5 V, | $V_I$ = 2.7 V | | | 20 | | | 20 | μA |
| | $\overline{PRE}$ | | | | | 40 | | | 40 | |
| $I_{IL}$ | J, K, or CLK | $V_{CC}$ = 5.5 V, | $V_I$ = 0.4 V | | | −0.2 | | | −0.2 | mA |
| | $\overline{PRE}$ | | | | | −0.4 | | | −0.4 | |
| $I_O$‡ | | $V_{CC}$ = 5.5 V, | $V_O$ = 2.25 V | −30 | | −112 | −30 | | −112 | mA |
| $I_{CC}$ | | $V_{CC}$ = 5.5 V, | See Note 1 | | 2.5 | 4.5 | | 2.5 | 4.5 | mA |

†All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
‡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 1: $I_{CC}$ is measured with J, K, CLK, and $\overline{PRE}$ grounded, then with J, K, CLK, and $\overline{CLR}$ grounded.

### switching characteristics (see Note 2)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC}$ = 4.5 V to 5.5 V, $C_L$ = 50 pF, $R_L$ = 500 Ω, $T_A$ = MIN to MAX | | | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | SN54ALS113A | | SN74ALS113A | | |
| | | | MIN | MAX | MIN | MAX | |
| $f_{max}$ | | | 25 | | 30 | | MHz |
| $t_{PLH}$ | $\overline{PRE}$ | Q or $\overline{Q}$ | 3 | 17 | 3 | 14 | ns |
| $t_{PHL}$ | | | 4 | 20 | 4 | 16 | |
| $t_{PLH}$ | CLK | Q or $\overline{Q}$ | 3 | 18 | 3 | 15 | ns |
| $t_{PHL}$ | | | 5 | 23 | 5 | 19 | |

NOTE 2: For load circuit and voltage waveforms, see page 1-12.





TEXAS INSTRUMENTS
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## recommended operating conditions

| | | | SN54AS113 | | | SN74AS113 | | | 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 |
| $I_{OH}$ | High-level output current | | | | −2 | | | −2 | mA |
| $I_{OL}$ | Low-level output current | | | | 20 | | | 20 | mA |
| $f_{clock}$ | Clock frequency | | 0 | | | 0 | | | MHz |
| $t_w$ | Pulse duration | $\overline{PRE}$ low | | | | | | | ns |
| | | CLK high | | | | | | | |
| | | CLK low | | | | | | | |
| $t_{su}$ | Setup time before CLK↓ | Data | | | | | | | ns |
| | | $\overline{PRE}$ inactive | | | | | | | |
| $t_h$ | Hold time, data after CLK↓ | | | | | | | | 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 | | SN54AS113 | | | SN74AS113 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP† | MAX | MIN | TYP† | MAX | |
| $V_{IK}$ | | $V_{CC}$ = 4.5 V, | $I_I$ = −18 mA | | | −1.2 | | | −1.2 | V |
| $V_{OH}$ | | $V_{CC}$ = 4.5 V to 5.5 V, | $I_{OH}$ = −2 mA | $V_{CC}$−2 | | | $V_{CC}$−2 | | | V |
| $V_{OL}$ | | $V_{CC}$ = 4.5 V, | $I_{OL}$ = 20 mA | | 0.35 | 0.5 | | 0.35 | 0.5 | V |
| $I_I$ | J or K | $V_{CC}$ = 5.5 V, | $V_I$ = 7 V | | | 0.1 | | | 0.1 | mA |
| | $\overline{PRE}$ | | | | | 0.5 | | | 0.5 | |
| | CLK | | | | | 0.5 | | | 0.5 | |
| $I_{IH}$ | J or K | $V_{CC}$ = 5.5 V, | $V_I$ = 2.7 V | | | 0.02 | | | 0.02 | mA |
| | $\overline{PRE}$ | | | | | 0.1 | | | 0.1 | |
| | CLK | | | | | 0.1 | | | 0.1 | |
| $I_{IL}$ | J or K | $V_{CC}$ = 5.5 V, | $V_I$ = 0.4 V | | −1 | | | −1 | | mA |
| | $\overline{PRE}$ | | | | −5.5 | | | −5.5 | | |
| | CLR | | | | −5 | | | −5 | | |
| $I_O$‡ | | $V_{CC}$ = 5.5 V, | $V_O$ = 2.25 V | −30 | | −112 | −30 | | −112 | mA |
| $I_{CC}$ | | $V_{CC}$ = 5.5 V, | See Note 1 | | 38 | | | 38 | | mA |

NOTE 1: $I_{CC}$ is measured with D, CLK, and $\overline{PRE}$ grounded, then with D, CLK, and CLR grounded.

## switching characteristics (see Note 2)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC}$ = 4.5 V to 5.5 V, $C_L$ = 50 pF, $R_L$ = 500 Ω, $T_A$ = MIN to MAX | | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | SN54AS113 | | | SN74AS113 | | | |
| | | | MIN | TYP† | MAX | MIN | TYP† | MAX | |
| $f_{max}$ | | | | 175 | | | 175 | | MHz |
| $t_{PLH}$ | $\overline{PRE}$ | Q or $\overline{Q}$ | | 3 | | | 3 | | ns |
| $t_{PHL}$ | | | | 4 | | | 4 | | |
| $t_{PLH}$ | CLK | Q or $\overline{Q}$ | | 3 | | | 3 | | ns |
| $t_{PHL}$ | | | | 4 | | | 4 | | |

†All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
‡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 2: For load circuit and voltage waveforms, see page 1-12.

**Additional information on these products can be obtained from the factory as it becomes available.**



**PRODUCT PREVIEW**

# 2

# ALS AND AS CIRCUITS