



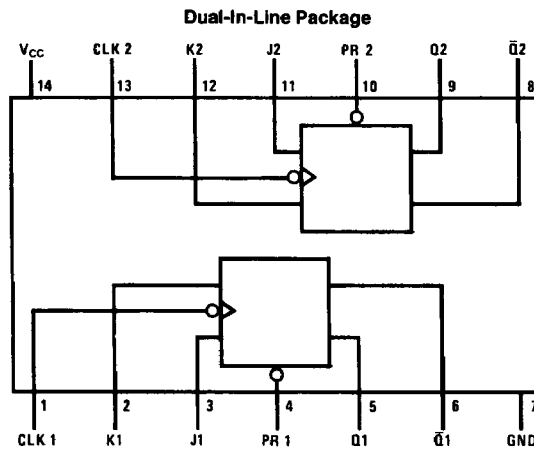
# DM54S113/DM74S113 Dual Negative-Edge-Triggered Master-Slave J-K Flip-Flops with Preset and Complementary Outputs

## General Description

This device contains two independent negative-edge-triggered J-K flip-flops with complementary outputs. The J and K data is processed by the flip-flops on the falling edge of the clock pulse. The clock triggering occurs at a voltage level and is not directly related to the transition time of the

negative going edge of the clock pulse. Data on the J and K inputs may be changed while the clock is high or low without affecting the outputs as long as setup and hold times are not violated. A low logic level on the preset input will set the outputs regardless of the logic levels of the other inputs.

## Connection Diagram



TL/F/6460-1

Order Number DM54S113J or DM74S113N  
See NS Package Number J14A or N14A

## Function Table

| Inputs |     |   |   | Outputs |             |
|--------|-----|---|---|---------|-------------|
| PR     | CLK | J | K | Q       | $\bar{Q}$   |
| L      | X   | X | X | H       | L           |
| H      | ↓   | L | L | $Q_0$   | $\bar{Q}_0$ |
| H      | ↓   | H | L | H       | L           |
| H      | ↓   | L | H | L       | H           |
| H      | ↓   | H | H | Toggle  |             |
| H      | H   | X | X | $Q_0$   | $\bar{Q}_0$ |

H = High Logic Level

X = Either Low or High Logic Level

L = Low Logic Level

↓ = Negative going edge of pulse.

 $Q_0$  = The output logic level of Q before the indicated input conditions were established.

Toggle = Each output changes to the complement of its previous level on each falling edge of the clock pulse.

## Absolute Maximum Ratings (Note)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|                                      |                 |
|--------------------------------------|-----------------|
| Supply Voltage                       | 7V              |
| Input Voltage                        | 5.5V            |
| Operating Free Air Temperature Range |                 |
| DM54S                                | -55°C to +125°C |
| DM74S                                | 0°C to +70°C    |
| Storage Temperature Range            | -65°C to +150°C |

Note: 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" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

## Recommended Operating Conditions (See Section 1 for Test Waveforms and Output Load)

| Symbol           | Parameter                      | DM54S113   |     |     | DM74S113 |     |      | Units |
|------------------|--------------------------------|------------|-----|-----|----------|-----|------|-------|
|                  |                                | Min        | Nom | Max | Min      | Nom | Max  |       |
| V <sub>CC</sub>  | Supply Voltage                 | 4.5        | 5   | 5.5 | 4.75     | 5   | 5.25 | V     |
| V <sub>IH</sub>  | High Level Input Voltage       | 2          |     |     | 2        |     |      | V     |
| V <sub>IL</sub>  | Low Level Input Voltage        |            |     | 0.8 |          |     | 0.8  | V     |
| I <sub>OH</sub>  | High Level Output Current      |            |     | -1  |          |     | -1   | mA    |
| I <sub>OL</sub>  | Low Level Output Current       |            |     | 20  |          |     | 20   | mA    |
| f <sub>CLK</sub> | Clock Frequency (Note 2)       | 0          | 125 | 80  | 0        | 125 | 80   | MHz   |
| f <sub>CLK</sub> | Clock Frequency (Note 3)       | 0          | 80  | 60  | 0        | 80  | 60   | MHz   |
| t <sub>w</sub>   | Pulse Width (Note 2)           | Clock High | 6   |     | 6        |     |      | ns    |
|                  |                                | Clock Low  | 6.5 |     | 6.5      |     |      |       |
|                  |                                | Preset Low | 8   |     | 8        |     |      |       |
| t <sub>w</sub>   | Pulse Width (Note 3)           | Clock High | 8   |     | 8        |     |      | ns    |
|                  |                                | Clock Low  | 8   |     | 8        |     |      |       |
|                  |                                | Preset Low | 10  |     | 10       |     |      |       |
| t <sub>SU</sub>  | Setup Time (Notes 1 & 4)       | 7 ↓        |     |     | 7 ↓      |     |      | ns    |
| t <sub>H</sub>   | Input Hold Time (Notes 1 & 4)  | 0 ↓        |     |     | 0 ↓      |     |      | ns    |
| T <sub>A</sub>   | Free Air Operating Temperature | -55        |     | 125 | 0        |     | 70   | °C    |

**Note 1:** The symbol (↓) indicates the falling edge at the clock pulse is used for reference.

**Note 2:** C<sub>L</sub> = 15 pF, R<sub>L</sub> = 280Ω, T<sub>A</sub> = 25°C and V<sub>CC</sub> = 5V.

**Note 3:** C<sub>L</sub> = 50 pF, R<sub>L</sub> = 280Ω, T<sub>A</sub> = 25°C and V<sub>CC</sub> = 5V.

**Note 4:** T<sub>A</sub> = 25°C and V<sub>CC</sub> = 5V.

## Electrical Characteristics

over recommended operating free air temperature (unless otherwise noted)

| Symbol   | Parameter                         | Conditions   | Min    | Typ<br>(Note 1) | Max  | Units         |
|----------|-----------------------------------|--|--------|-----------------|------|---------------|
| $V_I$    | Input Clamp Voltage               | $V_{CC} = \text{Min}, I_I = -18 \text{ mA}$  |        |                 | -1.2 | V             |
| $V_{OH}$ | High Level Output Voltage         | $V_{CC} = \text{Min}, I_{OH} = \text{Max}$<br>$V_{IL} = \text{Max}, V_{IH} = \text{Min}$ | DM54   | 2.5             | 3.4  | V             |
|          |                                   |  | DM74   | 2.7             | 3.4  |               |
| $V_{OL}$ | Low Level Output Voltage          | $V_{CC} = \text{Min}, I_{OL} = \text{Max}$<br>$V_{IH} = \text{Min}, V_{IL} = \text{Max}$ |        |                 | 0.5  | V             |
| $I_I$    | Input Current @ Max Input Voltage | $V_{CC} = \text{Max}, V_I = 5.5 \text{ V}$   |        |                 | 1    | mA            |
| $I_{IH}$ | High Level Input Current          | $V_{CC} = \text{Max}$<br>$V_I = 2.7 \text{ V}$   | J, K   |                 | 50   | $\mu\text{A}$ |
|          |                                   |  | Preset |                 | 100  |               |
|          |                                   |  | Clock  |                 | 100  |               |
| $I_{IL}$ | Low Level Input Current           | $V_{CC} = \text{Max}$<br>$V_I = 0.5 \text{ V}$   | J, K   |                 | -1.6 | mA            |
|          |                                   |  | Preset |                 | -7   |               |
|          |                                   |  | Clock  |                 | -4   |               |
| $I_{OS}$ | Short Circuit Output Current      | $V_{CC} = \text{Max}$<br>(Note 2)  | DM54   | -40             | -100 | mA            |
|          |                                   |  | DM74   | -40             | -100 |               |
| $I_{CC}$ | Supply Current                    | $V_{CC} = \text{Max}, (\text{Note 3})$   |        | 30              | 50   | mA            |

Note 1: All typicals are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

Note 2: Not more than one output should be shorted at a time, and the duration should not exceed one second.

Note 3: With all outputs open,  $I_{CC}$  is measured with the Q and  $\bar{Q}$  outputs high in turn. At the time of measurement, the clock input is grounded.

## Switching Characteristics

at  $V_{CC} = 5 \text{ V}$  and  $T_A = 25^\circ\text{C}$  (See Section 1 for Test Waveforms and Output Load)

| Symbol    | Parameter  | From (Input)<br>To (Output) | $R_L = 280\Omega$     |     |                       |     | Units |
|-----------|--|-----------------------------|-----------------------|-----|-----------------------|-----|-------|
|           |  |                             | $C_L = 15 \text{ pF}$ |     | $C_L = 50 \text{ pF}$ |     |       |
|           |  |                             | Min                   | Max | Min                   | Max |       |
| $f_{MAX}$ | Maximum Clock Frequency                            |                             | 80                    |     | 60                    | MHz |       |
| $t_{PLH}$ | Propagation Delay Time<br>Low to High Level Output | Preset<br>to Q              |                       | 7   |                       | 9   | ns    |
| $t_{PHL}$ | Propagation Delay Time<br>High to Low Level Output | Preset<br>to $\bar{Q}$      |                       | 7   |                       | 12  | ns    |
| $t_{PLH}$ | Propagation Delay Time<br>Low to High Level Output | Clock to<br>Q or $\bar{Q}$  |                       | 7   |                       | 9   | ns    |
| $t_{PHL}$ | Propagation Delay Time<br>High to Low Level Output | Clock to<br>Q or $\bar{Q}$  |                       | 7   |                       | 12  | ns    |