

GD54/74HC76, GD54/74HCT76

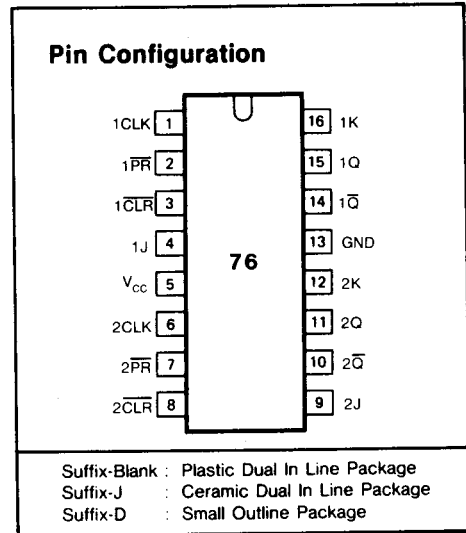
DUAL J-K FLIP-FLOPS WITH PRESET & CLEAR

General Description

These devices are identical in pinout to the 54/74LS76. These flip-flops are edge sensitive to the clock input and change state on the negative going transition of the clock pulse. Each flip-flop has independent J, K, clock, preset, and clear inputs and Q and \bar{Q} outputs. Clear and preset are independent of the clock and accomplished by a low logic level on the corresponding input. These devices are characterized for operation over wide temperature ranges to meet industry and military specifications.

Features

- Low Power consumption characteristic of CMOS devices
- Output drive capability: 10 LS TTL Loads Min.
- Operating speed superior to LS TTL
- Wide operating voltage range: for HC 2 to 6 volts
for HCT 4.5 to 5.5 volts
- Low input current: 1 μ A Max.
- Low quiescent current: 40 μ A Max. (74HC)
- High noise immunity characteristic of CMOS
- Diode protection on all inputs



Function Table

| INPUTS | | | | | OUTPUTS | |
|-----------------|------------------|--------------|---|---|----------------|------------------------|
| \overline{PR} | \overline{CLR} | CLK | J | K | Q | \bar{Q} |
| L | H | X | X | X | H | L |
| H | L | X | X | X | L | H |
| L | L | X | X | X | H \uparrow | H \uparrow |
| H | H | \downarrow | L | L | Q ₀ | \bar{Q} ₀ |
| H | H | \downarrow | H | L | H | L |
| H | H | \downarrow | L | H | L | H |
| H | H | \downarrow | H | H | TOGGLE | |
| H | H | H | X | X | Q ₀ | \bar{Q} ₀ |

* This configuration is nonstable; that is it will not persist when either preset or clear returns to its inactive (high) level.

Absolute Maximum Ratings

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|------------------|----------------------------------|--|------|------------|------|
| V_{CC} | DC Supply voltage | | -0.5 | +7 | V |
| I_{IK}, I_{OK} | DC input or output diode current | for $V_I < -0.5$ or $V_I > V_{CC} + 0.5$ V | | 20 | mA |
| I_O | DC output source or sink current | for -0.5 V $< V_O < V_{CC} + 0.5$ V | | 25 | mA |
| I_{CC} | DC V_{CC} or GND current | | | 50 | mA |
| T_{stg} | Storage temperature range | | -65 | 150 | °C |
| P_D | Power dissipation per package | above +70°C: derate linearly with 8mW/K | | 500 | mW |
| T | Lead temperature | At distance 1/16±1/32 in. from case for 60 sec(CERAMIC) 10 sec(PLASTIC) | | 300 260 | °C |

Recommended Operating Conditions

| CHARACTERISTIC | LIMITS | | UNITS |
|--|------------|---------------------------|-------|
| | MIN. | MAX. | |
| Supply-Voltage Range V_{CC} : GD54/74HC Types GD54/74HCT Types | 2 4.5 | 6 5.5 | V |
| DC Input or Output Voltage V_I, V_O | 0 | V_{CC} | V |
| Operating Temperature T_A : GD74 Types GD54 Types | -40 -55 | +85 +125 | °C |
| Input Rise and Fall times t_r, t_f : GD54/74HC Types at 2V at 4.5V at 6V GD54/74HCT Types at 4.5V | | 1000 500 400 500 | ns |

Logic Diagram

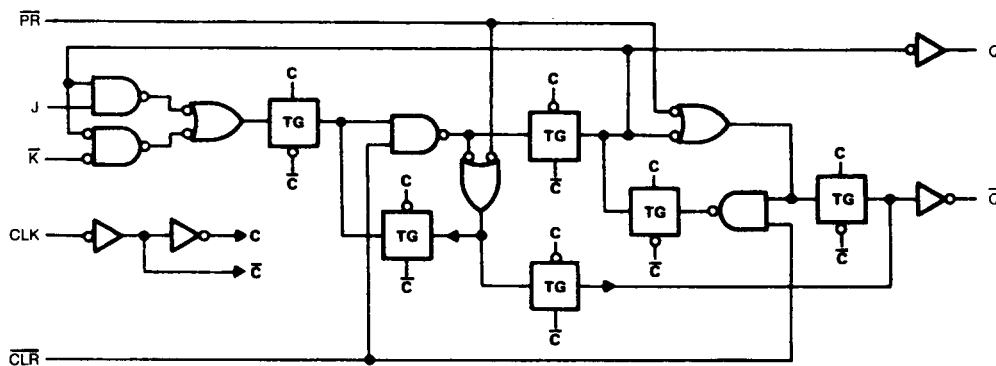


Fig. 1 Logic diagram (one flip-flop)

DC Electrical Characteristics for HC

| SYMBOL | PARAMETER | TEST CONDITION | V _{CC} (V) | T _A =25°C | | | GD74HC76 | | GD54HC76 | | UNIT |
|-----------------|---------------------------|--|------------------------|----------------------|------|------|----------|------|----------|------|------|
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| V _{IH} | HIGH level input Voltage | | 2.0 | 1.5 | | | 1.5 | | 1.5 | | V |
| | | | 4.5 | 3.15 | | | 3.15 | | 3.15 | | |
| | | | 6.0 | 4.2 | | | 4.2 | | 4.2 | | |
| V _{IL} | LOW level input voltage | | 2.0 | | | 0.3 | | 0.3 | | 0.3 | V |
| | | | 4.5 | | | 0.9 | | 0.9 | | 0.9 | |
| | | | 6.0 | | | 1.2 | | 1.2 | | 1.2 | |
| V _{OH} | HIGH level output voltage | V _{IN} =V _{IH} | 2.0 | 1.9 | 2.0 | | 1.9 | | 1.9 | | V |
| | | | 4.5 | 4.4 | 4.5 | | 4.4 | | 4.4 | | |
| | 6.0 | 5.9 | 6.0 | | 5.9 | | 5.9 | | | | |
| | or V _{IL} | I _{OH} =-4mA I _{OH} =-5.2mA | 4.5 | 3.98 | 4.3 | | 3.84 | | 3.7 | | |
| 6.0 | | | 5.48 | 5.2 | | 5.34 | | 5.2 | | | |
| V _{OL} | LOW level output voltage | V _{IN} =V _{IH} | 2.0 | | | 0.1 | | 0.1 | | 0.1 | V |
| | | | 4.5 | | | 0.1 | | 0.1 | | 0.1 | |
| | 6.0 | | | 0.1 | | 0.1 | | 0.1 | | | |
| | or V _{IL} | I _{OL} =4mA I _{OL} =5.2mA | 4.5 | | 0.17 | 0.26 | | 0.33 | | 0.4 | |
| 6.0 | | | | 0.15 | 0.26 | | 0.33 | | 0.4 | | |
| I _{IN} | Input leakage Current | V _{IN} =V _{CC} or GND | 6.0 | | | 0.1 | | 1.0 | | 1.0 | μA |
| I _{CC} | Quiescent Supply Current | V _{IN} =V _{CC} or GND I _{out} =0μA | 6.0 | | | 4 | | 40 | | 80 | μA |

DC Electrical Characteristics for HCT

| SYMBOL | PARAMETER | TEST CONDITION | V _{CC} (V) | T _A =25°C | | | GD74HCT76 | | GD54HCT76 | | UNIT |
|-----------------|---------------------------|--|------------------------|----------------------|------|------|-----------|------|-----------|------|------|
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| V _{IH} | HIGH level input Voltage | | 4.5 | | | | | | | | V |
| | | | to 5.5 | 2.0 | | | 2.0 | | 2.0 | | |
| V _{IL} | LOW level input voltage | | 4.5 | | | | | | | | V |
| | | | to 5.5 | | | 0.8 | | 0.8 | | 0.8 | |
| V _{OH} | HIGH level output voltage | V _{IN} =V _{IH} | 4.5 | 4.4 | 4.5 | | 4.4 | | 4.4 | | V |
| | | | 4.5 | 3.98 | 4.3 | | 3.84 | | 3.7 | | |
| | or V _{IL} | I _{OH} =-4mA | 4.5 | | | | | | | | |
| | | | 4.5 | | | | | | | | |
| V _{OL} | LOW level output voltage | V _{IN} =V _{IH} | 4.5 | | | 0.1 | | 0.1 | | 0.1 | V |
| | | | 4.5 | | | 0.1 | | 0.1 | | 0.1 | |
| | or V _{IL} | I _{OL} =4mA | 4.5 | | 0.17 | 0.26 | | 0.33 | | 0.4 | |
| | | | 4.5 | | 0.17 | 0.26 | | 0.33 | | 0.4 | |
| I _{IN} | Input leakage Current | V _{IN} =V _{CC} or GND | 5.5 | | | 0.1 | | 1.0 | | 1.0 | μA |
| I _{CC} | Quiescent Supply Current | V _{IN} =V _{CC} or GND I _{out} =0μA | 5.5 | | | 4 | | 40 | | 80 | μA |

Timing Requirements for HC: $t_r=t_f=6ns$ $C_L=50$ pF

| SYMBOL | PARAMETER | | V_{CC} (V) | $T_A=25^\circ C$ | | | GD74HC76 | | GD54HC76 | | UNIT |
|-----------|---------------|--|-----------------|------------------|------|------|----------|------|----------|------|------|
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| t_w | Pulse width | $\overline{PR}, \overline{CLR}$ | 2.0 | 80 | 30 | | 100 | | 120 | | ns |
| | | | 4.5 | 16 | 10 | | 20 | | 25 | | |
| | | | 6.0 | 14 | 8 | | 18 | | 22 | | |
| | | CLK | 2.0 | 80 | 30 | | 100 | | 120 | | ns |
| | | | 4.5 | 16 | 10 | | 20 | | 25 | | |
| | | | 6.0 | 14 | 8 | | 18 | | 22 | | |
| t_{su} | Set up Time | Data to CLK | 2.0 | 60 | 30 | | 80 | | 100 | | ns |
| | | | 4.5 | 15 | 10 | | 18 | | 20 | | |
| | | | 6.0 | 14 | 8 | | 16 | | 18 | | |
| t_{rec} | Recovery time | $\overline{PR}, \overline{CLR}$ to CLK | 2.0 | 5 | 0 | | 5 | | 5 | | ns |
| | | | 4.5 | 5 | 0 | | 5 | | 5 | | |
| | | | 6.0 | 5 | 0 | | 5 | | 5 | | |
| t_h | Hold Time | CLK to Data | 2.0 | 3 | 0 | | 3 | | 3 | | ns |
| | | | 4.5 | 3 | 0 | | 3 | | 3 | | |
| | | | 6.0 | 3 | 0 | | 3 | | 3 | | |

AC Characteristics for HC: $t_r=t_f=6ns$ $C_L=50$ pF

| SYMBOL | PARAMETER | | V_{CC} (V) | $T_A=25^\circ C$ | | | GD74HC76 | | GD54HC76 | | UNIT |
|--------------------------|--|-----|-----------------|------------------|------|------|----------|------|----------|------|------|
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| f_{max} | Maximum Clock Pulse Frequency | 2.0 | 6 | 20 | | 5 | | 4 | | MHz | |
| | | 4.5 | 30 | 65 | | 25 | | 20 | | | |
| | | 6.0 | 35 | 75 | | 30 | | 25 | | | |
| $t_{PLH} /$ t_{PHL} | Propagation Delay Time nCLK to nQ | 2.0 | | 46 | 160 | | 200 | | 240 | ns | |
| | | 4.5 | | 15 | 30 | | 40 | | 50 | | |
| | | 6.0 | | 14 | 28 | | 35 | | 45 | | |
| $t_{PLH} /$ t_{PHL} | Propagation Delay Time nCLK to n \overline{Q} | 2.0 | | 50 | 160 | | 200 | | 240 | ns | |
| | | 4.5 | | 17 | 30 | | 40 | | 50 | | |
| | | 6.0 | | 16 | 28 | | 35 | | 45 | | |
| $t_{PLH} /$ t_{PHL} | Propagation Delay Time n \overline{PR} to nQ, n \overline{Q} | 2.0 | | 45 | 155 | | 190 | | 230 | ns | |
| | | 4.5 | | 15 | 28 | | 38 | | 45 | | |
| | | 6.0 | | 14 | 26 | | 34 | | 42 | | |
| $t_{PLH} /$ t_{PHL} | Propagation Delay time n \overline{CLR} to nQ, n \overline{Q} | 2.0 | | 45 | 155 | | 190 | | 230 | ns | |
| | | 4.5 | | 15 | 28 | | 38 | | 45 | | |
| | | 6.8 | | 14 | 26 | | 34 | | 42 | | |
| $t_{TLH} /$ t_{THL} | Output Transition time | 2.0 | | 25 | 70 | | 85 | | 100 | ns | |
| | | 4.5 | | 8 | 15 | | 18 | | 22 | | |
| | | 6.0 | | 7 | 13 | | 16 | | 19 | | |

Timing Requirements for HCT: $t_r=t_f=6\text{ns}$ $C_L=50\text{ pF}$

| SYMBOL | PARAMETER | | V _{CC} (V) | T _A =25°C | | | GD74HCT76 | | GD54HCT76 | | UNIT |
|------------------|---------------|----------------|------------------------|----------------------|------|------|-----------|------|-----------|------|------|
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| t _w | Pulse width | PR, CLR | 4.5 | 18 | 10 | | 20 | | 25 | | ns |
| | | CLK | 4.5 | 16 | 10 | | 20 | | 25 | | ns |
| t _{su} | Set up Time | Data to CLK | 4.5 | 15 | 10 | | 18 | | 20 | | ns |
| t _{rec} | Recovery time | PR, CLR to CLK | 4.5 | 5 | 0 | | 5 | | 5 | | ns |
| t _h | Hold Time | CLK to Data | 4.5 | 3 | 0 | | 3 | | 3 | | ns |

AC Characteristics for HCT: $t_r=t_f=6\text{ns}$ $C_L=50\text{ pF}$

| SYMBOL | PARAMETER | | V _{CC} (V) | T _A =25°C | | | GD74HCT76 | | GD54HCT76 | | UNIT |
|--|--|--|------------------------|----------------------|------|------|-----------|------|-----------|------|------|
| | | | | MIN. | TYP. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| f _{max} | Maximum Clock Pulse Frequency | | 4.5 | 27 | 54 | | 22 | | 18 | | MHz |
| t _{PLH} / t _{PHL} | Propagation Delay Time nCLK to nQ | | 4.5 | | 17 | 30 | | 40 | | 50 | ns |
| t _{PLH} / t _{PHL} | Propagation Delay Time nCLK to nQ̄ | | 4.5 | | 17 | 30 | | 40 | | 50 | ns |
| t _{PLH} / t _{PHL} | Propagation Delay Time nPR̄ to nQ, nQ̄ | | 4.5 | | 15 | 28 | | 38 | | 45 | ns |
| t _{PLH} / t _{PHL} | Propagation Delay time nCLR̄ to nQ, nQ̄ | | 4.5 | | 15 | 28 | | 38 | | 45 | ns |
| t _{TLH} / t _{THL} | Output Transition time | | 4.5 | | 8 | 15 | | 18 | | 22 | ns |

AC Waveforms

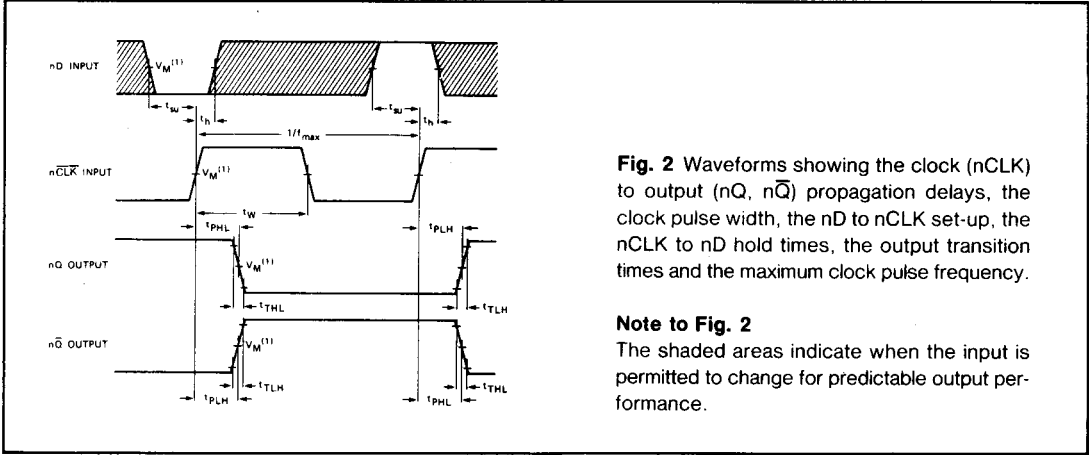


Fig. 2 Waveforms showing the clock (nCLK) to output (nQ, nQ̄) propagation delays, the clock pulse width, the nD to nCLK set-up, the nCLK to nD hold times, the output transition times and the maximum clock pulse frequency.

Note to Fig. 2
The shaded areas indicate when the input is permitted to change for predictable output performance.

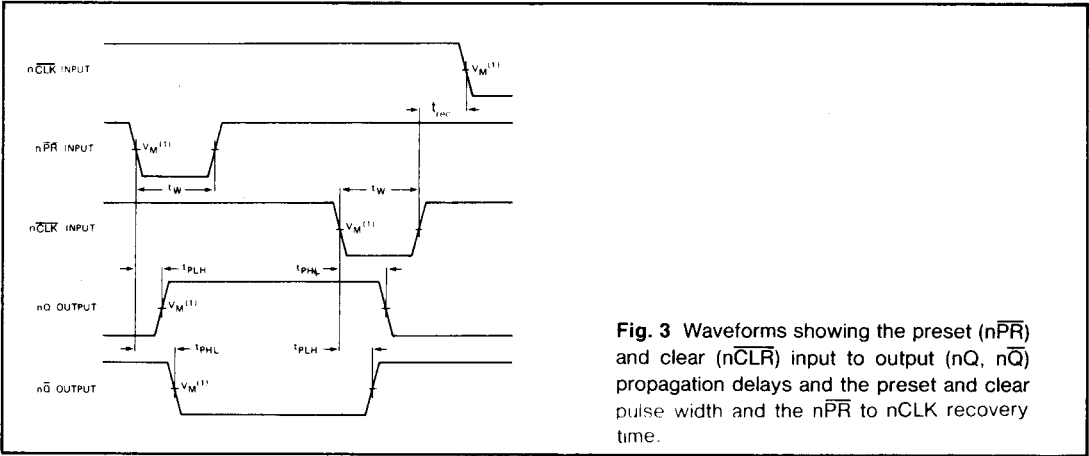


Fig. 3 Waveforms showing the preset (nPR) and clear (nCLR) input to output (nQ, nQ̄) propagation delays and the preset and clear pulse width and the nPR to nCLK recovery time.

Note to AC waveforms

- (1) HC : $V_M = 50\%$; $V_I = \text{GND to } V_{CC}$.
- HCT : $V_M = 1.3V$; $V_I = \text{GND to } 3V$.