

# GD54/74HC76, GD54/74HCT76

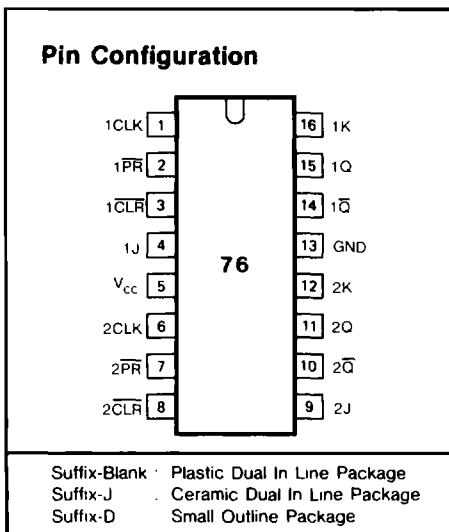
## DUAL J-K FLIP-FLOPS WITH PRESET & CLEAR

### 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  $\mu$ A Max.
- Low quiescent current: 40  $\mu$ A Max. (74HC)
- High noise immunity characteristic of CMOS
- Diode protection on all inputs



### Function Table

| INPUTS |     |     |   |   | OUTPUTS        |                        |
|--------|-----|-----|---|---|----------------|------------------------|
| PR     | 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†             | H†                     |
| H      | H   | ↓   | L | L | Q <sub>0</sub> | $\bar{Q}$ <sub>0</sub> |
| H      | H   | ↓   | H | L | H              | L                      |
| H      | H   | ↓   | L | H | L              | H                      |
| H      | H   | ↓   | H | H | TOGGLE         |                        |
| H      | H   | H   | X | X | Q <sub>0</sub> | $\bar{Q}$ <sub>0</sub> |

\* 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<br>derate linearly with 8mW/K   |      | 500        | mW   |
| T                | Lead temperature                 | At distance 1/16 ± 1/32 in<br>from case<br>for 60 sec(CERAMIC)<br>10 sec(PLASTIC) |      | 300<br>260 | °C   |

**Recommended Operating Conditions**

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

**Logic Diagram**

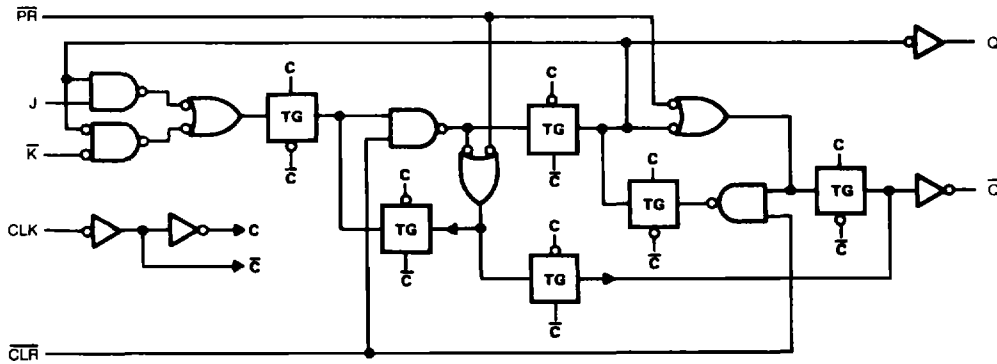


Fig. 1 Logic diagram (one flip-flop)

DC Electrical Characteristics for HC

| SYMBOL          | PARAMETER                 | TEST CONDITION   | V <sub>CC</sub><br>(V)  | T <sub>A</sub> =25°C |      |      | GD74HC76 |      | GD54HC76 |      | UNIT |   |     |
|-----------------|---------------------------|--|-------------------------|----------------------|------|------|----------|------|----------|------|------|---|-----|
|                 |                           |  |                         | MIN.                 | TYP. | MAX. | MIN.     | MAX. | MIN.     | MAX. |      |   |     |
| V <sub>IH</sub> | 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 <sub>IL</sub> | 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 <sub>OH</sub> | HIGH level output voltage | V <sub>IN</sub> =V <sub>IH</sub>                                 | I <sub>OH</sub> =-20μA  | 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 <sub>IL</sub>   | I <sub>OH</sub> =-4mA   | 4.5                  | 3.98 | 4.3  |          |      | 3.84     |      | 3.7  |   |     |
|                 |                           |  |                         | 6.0                  | 5.48 | 5.2  |          |      | 5.34     |      | 5.2  |   |     |
|                 |                           |  | I <sub>OH</sub> =-5.2mA | 6.0                  |      |      |          |      |          |      |      |   |     |
| V <sub>OL</sub> | LOW level output voltage  | V <sub>IN</sub> =V <sub>IH</sub>                                 | I <sub>OL</sub> =20μA   | 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 <sub>IL</sub>   | I <sub>OL</sub> =4mA    | 4.5                  |      | 0.17 | 0.26     |      | 0.33     |      | 0.4  |   |     |
|                 |                           |  |                         |                      | 6.0  |      | 0.15     | 0.26 |          | 0.33 |      |   | 0.4 |
|                 |                           |  |                         |                      | 6.0  |      |          |      |          |      |      |   |     |
| I <sub>IN</sub> | Input leakage Current     | V <sub>IN</sub> =V <sub>CC</sub> or GND                          | 6.0                     |                      |      | 0.1  |          | 1.0  |          | 1.0  | μA   |   |     |
| I <sub>CC</sub> | Quiescent Supply Current  | V <sub>IN</sub> =V <sub>CC</sub> or GND<br>I <sub>out</sub> =0μA | 6.0                     |                      |      | 4    |          | 40   |          | 80   | μA   |   |     |

DC Electrical Characteristics for HCT

| SYMBOL          | PARAMETER                 | TEST CONDITION   | V <sub>CC</sub><br>(V) | T <sub>A</sub> =25°C |      |      | GD74HCT76 |      | GD54HCT76 |      | UNIT |   |     |
|-----------------|---------------------------|--|------------------------|----------------------|------|------|-----------|------|-----------|------|------|---|-----|
|                 |                           |  |                        | MIN.                 | TYP. | MAX. | MIN.      | MAX. | MIN.      | MAX. |      |   |     |
| V <sub>IH</sub> | HIGH level input Voltage  |  | 4.5                    |                      |      |      |           |      |           |      | V    |   |     |
|                 |                           |  | to 5.5                 | 2.0                  |      |      | 2.0       |      | 2.0       |      |      |   |     |
|                 |                           |  |                        |                      |      |      |           |      |           |      |      |   |     |
| V <sub>IL</sub> | LOW level input voltage   |  | 4.5                    |                      |      |      |           |      |           |      | V    |   |     |
|                 |                           |  | to 5.5                 |                      |      | 0.8  |           | 0.8  |           | 0.8  |      |   |     |
|                 |                           |  |                        |                      |      |      |           |      |           |      |      |   |     |
| V <sub>OH</sub> | HIGH level output voltage | V <sub>IN</sub> =V <sub>IH</sub>                                 | I <sub>OH</sub> =-20μA | 4.5                  | 4.4  | 4.5  |           |      | 4.4       |      | 4.4  | V |     |
|                 |                           |  |                        |                      | 4.5  | 3.98 | 4.3       |      |           | 3.84 |      |   | 3.7 |
|                 |                           |  |                        |                      | 6.0  |      |           |      |           |      |      |   |     |
|                 |                           | or V <sub>IL</sub>   | I <sub>OH</sub> =-4mA  | 4.5                  |      |      | 0.1       |      | 0.1       |      | 0.1  |   |     |
|                 |                           |  |                        |                      | 6.0  |      | 0.17      | 0.26 |           | 0.33 |      |   | 0.4 |
|                 |                           |  |                        |                      | 6.0  |      |           |      |           |      |      |   |     |
| I <sub>IN</sub> | Input leakage Current     | V <sub>IN</sub> =V <sub>CC</sub> or GND                          | 5.5                    |                      |      | 0.1  |           | 1.0  |           | 1.0  | μA   |   |     |
| I <sub>CC</sub> | Quiescent Supply Current  | V <sub>IN</sub> =V <sub>CC</sub> or GND<br>I <sub>out</sub> =0μA | 5.5                    |                      |      | 4    |           | 40   |           | 80   | μA   |   |     |

# GD54/74HC76, GD54/74HCT76

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

| SYMBOL    | PARAMETER     |  | $V_{CC}$<br>(V) | $T_A=25^\circ\text{C}$ |      |      | GD74HC76 |      | GD54HC76 |      | UNIT |
|-----------|---------------|--|-----------------|------------------------|------|------|----------|------|----------|------|------|
|           |               |  |                 | MIN.                   | TYP. | MAX. | MIN.     | MAX. | MIN.     | MAX. |      |
| $t_w$     | Pulse width   | $\overline{\text{PR}}, \overline{\text{CLR}}$        | 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 | $\overline{\text{PR}}, \overline{\text{CLR}}$ 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: $t_r=t_f=6\text{ns}$ $C_L=50\text{ pF}$

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

# GD54/74HC/HC76, GD54/74HCT76

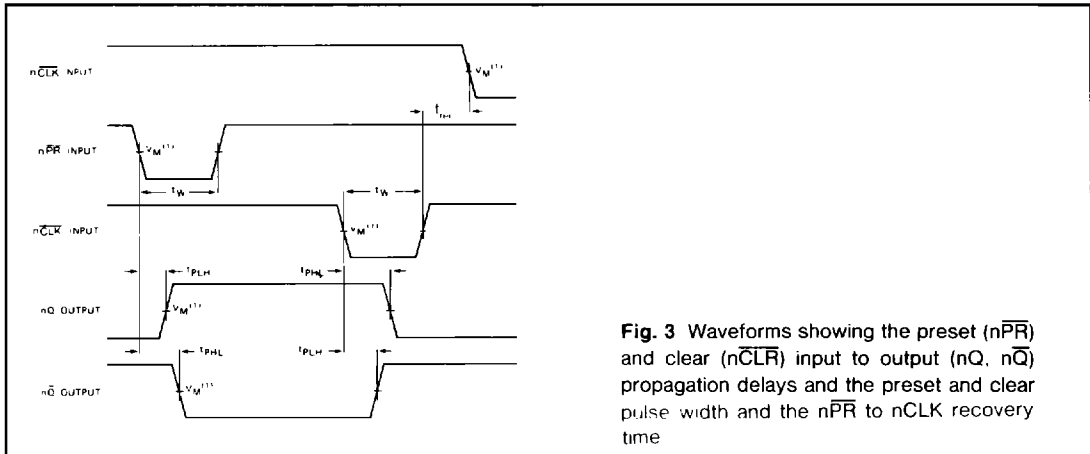
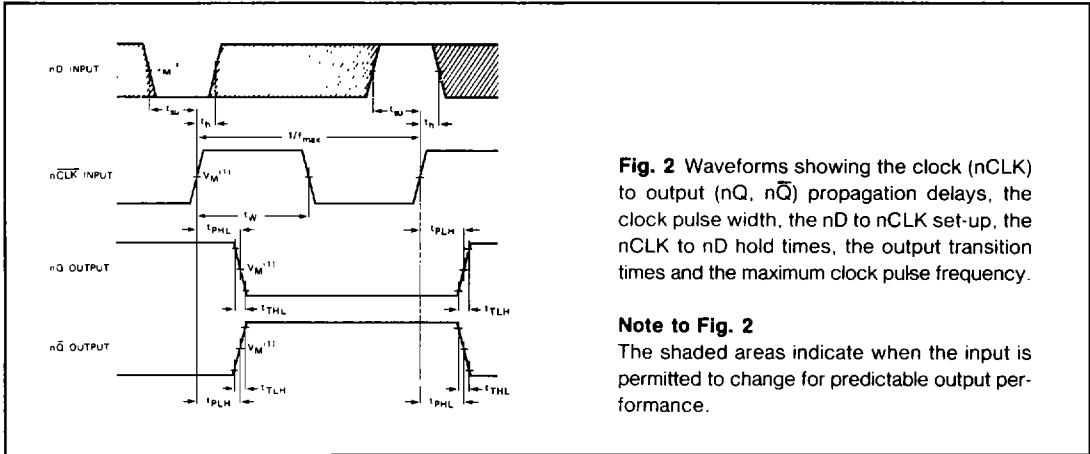
**Timing Requirements for HCT:**  $t_r=t_f=6\text{ns}$   $C_L=50\text{ pF}$

| SYMBOL           | PARAMETER     |                | V <sub>CC</sub><br>(V) | T <sub>A</sub> =25°C |      |      | GD74HCT76 |      | GD54HCT76 |      | UNIT |
|------------------|---------------|----------------|------------------------|----------------------|------|------|-----------|------|-----------|------|------|
|                  |               |                |                        | MIN.                 | TYP. | MAX. | MIN.      | MAX. | MIN.      | MAX. |      |
| t <sub>w</sub>   | Pulse width   | PR, CLR        | 4.5                    | 18                   | 10   |      | 20        |      | 25        |      | ns   |
|                  |               | CLK            | 4.5                    | 16                   | 10   |      | 20        |      | 25        |      | ns   |
| t <sub>su</sub>  | Set up Time   | Data to CLK    | 4.5                    | 15                   | 10   |      | 18        |      | 20        |      | ns   |
| t <sub>rec</sub> | Recovery time | PR, CLR to CLK | 4.5                    | 5                    | 0    |      | 5         |      | 5         |      | ns   |
| t <sub>h</sub>   | 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 <sub>CC</sub><br>(V) | T <sub>A</sub> =25°C |      |      | GD74HCT76 |      | GD54HCT76 |      | UNIT |
|--|---|--|------------------------|----------------------|------|------|-----------|------|-----------|------|------|
|  |   |  |                        | MIN.                 | TYP. | MAX. | MIN.      | MAX. | MIN.      | MAX. |      |
| f <sub>max</sub>                       | Maximum Clock Pulse Frequency             |  | 4.5                    | 27                   | 54   |      | 22        |      | 18        |      | MHz  |
| t <sub>PLH</sub> /<br>t <sub>PHL</sub> | Propagation Delay Time<br>nCLK to nQ      |  | 4.5                    |                      | 17   | 30   |           | 40   |           | 50   | ns   |
| t <sub>PLH</sub> /<br>t <sub>PHL</sub> | Propagation Delay Time<br>nCLK to nQ̄     |  | 4.5                    |                      | 17   | 30   |           | 40   |           | 50   | ns   |
| t <sub>PLH</sub> /<br>t <sub>PHL</sub> | Propagation Delay Time<br>nPR to nQ, nQ̄  |  | 4.5                    |                      | 15   | 28   |           | 38   |           | 45   | ns   |
| t <sub>PLH</sub> /<br>t <sub>PHL</sub> | Propagation Delay time<br>nCLR to nQ, nQ̄ |  | 4.5                    |                      | 15   | 28   |           | 38   |           | 45   | ns   |
| t <sub>TLH</sub> /<br>t <sub>THL</sub> | Output Transition time                    |  | 4.5                    |                      | 8    | 15   |           | 18   |           | 22   | ns   |

AC Waveforms



Note to AC waveforms

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