CD4013BC
Dual D-Type Flip-Flop

General Description
The CD4013B dual D-type flip-flop is a monolithic complementary MOS (CMOS) integrated circuit constructed with N- and P- channel enhancement mode transistors. Each flip-flop has independent data, set, reset, and clock inputs and "Q" and "Q" outputs. These devices can be used for shift register applications, and by connecting "Q" output to the data input, for counter and toggle applications. The logic level present at the "Q" input is transferred to the output during the positive-going transition of the clock pulse. Setting or resetting is independent of the clock and is accomplished by a high level on the set or reset line respectively.

Features
■ Wide supply voltage range: 3.0V to 15V
■ High noise immunity: 0.45 V_{DD} (typ.)
■ Low power TTL: fan out of 2 driving 74L compatibility: or 1 driving 74LS

Applications
• Automotive
• Data terminals
• Instrumentation
• Medical electronics
• Alarm systems
• Industrial electronics
• Remote metering
• Computers

Ordering Code:

<table>
<thead>
<tr>
<th>Order Number</th>
<th>Package Number</th>
<th>Package Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD4013BCM</td>
<td>M14A</td>
<td>14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150&quot; Narrow</td>
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<tr>
<td>CD4013BCSJ</td>
<td>M14D</td>
<td>14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide</td>
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<tr>
<td>CD4013BCN</td>
<td>N14A</td>
<td>14-Lead Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300&quot; Wide</td>
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Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Connection Diagram

Truth Table

<table>
<thead>
<tr>
<th>CL (Note 1)</th>
<th>D</th>
<th>R</th>
<th>S</th>
<th>Q</th>
<th>Q</th>
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<tr>
<td>~0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
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<tr>
<td>~1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
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<tr>
<td>~x</td>
<td>0</td>
<td>0</td>
<td>Q</td>
<td>Q</td>
<td></td>
</tr>
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<td>x</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

No Change
x = Don't Care Case
Note 1: Level Change
### Absolute Maximum Ratings (Note 2)

- DC Supply Voltage ($V_{DD}$): $-0.5\ V_{DC}$ to $+18\ V_{DC}$
- Input Voltage ($V_{IN}$): $-0.5\ V_{DC}$ to $V_{DD}$ or $0.5\ V_{DC}$
- Storage Temperature Range ($T_{S}$): $-65^\circ C$ to $+150^\circ C$
- Power Dissipation ($P_{D}$): Dual-In-Line 700 mW, Small Outline 500 mW
- Lead Temperature ($T_{L}$) (Soldering, 10 seconds): 260°C

### Recommended Operating Conditions (Note 3)

- DC Supply Voltage ($V_{DD}$): $+3\ V_{DC}$ to $+15\ V_{DC}$
- Input Voltage ($V_{IN}$): $0\ V_{DC}$ to $V_{DD}$
- Operating Temperature Range ($T_{A}$): $-40^\circ C$ to $+85^\circ C$

Note 2: "Absolute Maximum Ratings" are these values beyond which the safety of the device cannot be guaranteed, they are not meant to imply that the devices should be operated at these limits. The tables of "Recommended Operating Conditions" and "Electrical Characteristics" provide conditions for actual device operation.

Note 3: $V_{IN}$ = $0V$ unless otherwise specified.

### DC Electrical Characteristics (Note 3)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>$-40^\circ C$</th>
<th>$-25^\circ C$</th>
<th>$+85^\circ C$</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{DD}$</td>
<td>Quiescent Device Current</td>
<td>$V_{DD} = 5V, V_{IN} = V_{DD}$ or $V_{SS}$</td>
<td>4.0</td>
<td>4.0</td>
<td>30</td>
<td>μA</td>
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<tr>
<td></td>
<td>$V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$</td>
<td>8.0</td>
<td>8.0</td>
<td>60</td>
<td>μA</td>
<td></td>
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<tr>
<td></td>
<td>$V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$</td>
<td>16.0</td>
<td>16.0</td>
<td>120</td>
<td>μA</td>
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<tr>
<td>$V_{OL}$</td>
<td>LOW Level Output Voltage</td>
<td>$I_{OL} &lt; 1.0\ \mu A$</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>$V_{DD} = 5V$</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{DD} = 10V$</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{DD} = 15V$</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{OH}$</td>
<td>HIGH Level Output Voltage</td>
<td>$I_{OL} &lt; 1.0\ \mu A$</td>
<td>4.95</td>
<td>4.95</td>
<td>4.95</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>$V_{DD} = 5V$</td>
<td>4.95</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>$V_{DD} = 10V$</td>
<td>9.95</td>
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</tr>
<tr>
<td></td>
<td>$V_{DD} = 15V$</td>
<td>14.95</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$V_{IL}$</td>
<td>LOW Level Input Voltage</td>
<td>$I_{OL} &lt; 1.0\ \mu A$</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>$V_{DD} = 5V, V_{O} = 0.5V$ or $4.5V$</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>$V_{DD} = 10V, V_{O} = 1.0V$ or $9.0V$</td>
<td>3.0</td>
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<tr>
<td></td>
<td>$V_{DD} = 15V, V_{O} = 1.5V$ or $13.5V$</td>
<td>4.0</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>$V_{IH}$</td>
<td>HIGH Level Input Voltage</td>
<td>$I_{OL} &lt; 1.0\ \mu A$</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>$V_{DD} = 5V, V_{O} = 0.5V$ or $4.5V$</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>$V_{DD} = 10V, V_{O} = 1.0V$ or $9.0V$</td>
<td>7.0</td>
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<tr>
<td></td>
<td>$V_{DD} = 15V, V_{O} = 1.5V$ or $13.5V$</td>
<td>11.0</td>
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<tr>
<td>$I_{OL}$</td>
<td>LOW Level Output Current (Note 4)</td>
<td>$V_{OL} = 5V, V_{O} = 0.4V$</td>
<td>0.84</td>
<td>0.84</td>
<td>0.36</td>
<td>mA</td>
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<tr>
<td></td>
<td>$V_{DD} = 10V, V_{O} = 0.5V$</td>
<td>1.1</td>
<td>2.25</td>
<td>0.9</td>
<td>mA</td>
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<tr>
<td></td>
<td>$V_{DD} = 15V, V_{O} = 1.0V$</td>
<td>3.0</td>
<td>8.8</td>
<td>2.4</td>
<td>mA</td>
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<tr>
<td>$I_{OH}$</td>
<td>HIGH Level Output Current (Note 4)</td>
<td>$V_{OH} = 5V, V_{O} = 4.6V$</td>
<td>0.52</td>
<td>0.44</td>
<td>0.36</td>
<td>mA</td>
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<tr>
<td></td>
<td>$V_{DD} = 10V, V_{O} = 0.5V$</td>
<td>-1.3</td>
<td>-2.25</td>
<td>0.9</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_{DD} = 15V, V_{O} = 1.0V$</td>
<td>-3.6</td>
<td>-8.8</td>
<td>-2.4</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>$I_{IH}$</td>
<td>Input Current</td>
<td>$V_{OL} = 15V, V_{I} = 0V$</td>
<td>$-0.3</td>
<td>-10^{-2}$</td>
<td>-0.3</td>
<td>μA</td>
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<tr>
<td></td>
<td>$V_{OL} = 15V, V_{I} = 15V$</td>
<td>0.3</td>
<td>$10^{-4}$</td>
<td>0.3</td>
<td>μA</td>
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</tr>
</tbody>
</table>

Note 4: $I_{OH}$ and $I_{IH}$ are measured one output at a time.
### AC Electrical Characteristics (Note 5)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_{\text{PDLH}} )</td>
<td>Propagation Delay Time</td>
<td>( V_{DD} = 5\text{V} )</td>
<td>200</td>
<td>350</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( t_{\text{PDLH}} )</td>
<td></td>
<td>( V_{DD} = 10\text{V} )</td>
<td>80</td>
<td>160</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( t_{\text{PDLH}} )</td>
<td></td>
<td>( V_{DD} = 15\text{V} )</td>
<td>65</td>
<td>120</td>
<td>ns</td>
<td></td>
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<tr>
<td>( t_{\text{THL}} )</td>
<td>Transition Time</td>
<td>( V_{DD} = 5\text{V} )</td>
<td>100</td>
<td>200</td>
<td>ns</td>
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</tr>
<tr>
<td>( t_{\text{THL}} )</td>
<td></td>
<td>( V_{DD} = 10\text{V} )</td>
<td>50</td>
<td>100</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( t_{\text{THL}} )</td>
<td></td>
<td>( V_{DD} = 15\text{V} )</td>
<td>40</td>
<td>80</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( t_{\text{MC}, \text{MNH}} )</td>
<td>Minimum Clock Pulse Width</td>
<td>( V_{DD} = 5\text{V} )</td>
<td>100</td>
<td>200</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( t_{\text{MC}, \text{MNH}} )</td>
<td></td>
<td>( V_{DD} = 10\text{V} )</td>
<td>40</td>
<td>80</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( t_{\text{MC}, \text{MNH}} )</td>
<td></td>
<td>( V_{DD} = 15\text{V} )</td>
<td>32</td>
<td>65</td>
<td>ns</td>
<td></td>
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<tr>
<td>( t_{\text{RCL}}, t_{\text{FCL}} )</td>
<td>Maximum Clock Rise and Fall Time</td>
<td>( V_{DD} = 5\text{V} )</td>
<td>15</td>
<td>( \mu \text{s} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( t_{\text{RCL}}, t_{\text{FCL}} )</td>
<td></td>
<td>( V_{DD} = 10\text{V} )</td>
<td>10</td>
<td>( \mu \text{s} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( t_{\text{RCL}}, t_{\text{FCL}} )</td>
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<td>( V_{DD} = 15\text{V} )</td>
<td>5</td>
<td>( \mu \text{s} )</td>
<td></td>
<td></td>
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<tr>
<td>( t_{\text{SU}} )</td>
<td>Minimum Set-Up Time</td>
<td>( V_{DD} = 5\text{V} )</td>
<td>20</td>
<td>40</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( t_{\text{SU}} )</td>
<td></td>
<td>( V_{DD} = 10\text{V} )</td>
<td>15</td>
<td>30</td>
<td>ns</td>
<td></td>
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<tr>
<td>( t_{\text{SU}} )</td>
<td></td>
<td>( V_{DD} = 15\text{V} )</td>
<td>12</td>
<td>25</td>
<td>ns</td>
<td></td>
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<td>( t_{\text{CL}} )</td>
<td>Maximum Clock Frequency</td>
<td>( V_{DD} = 5\text{V} )</td>
<td>2.5</td>
<td>5</td>
<td>MHz</td>
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<td>( t_{\text{CL}} )</td>
<td></td>
<td>( V_{DD} = 10\text{V} )</td>
<td>6.2</td>
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<td>( t_{\text{CL}} )</td>
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<td>( V_{DD} = 15\text{V} )</td>
<td>7.6</td>
<td>15.5</td>
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#### SET AND RESET OPERATION

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<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_{\text{PDLH}} )</td>
<td>Propagation Delay Time</td>
<td>( V_{DD} = 5\text{V} )</td>
<td>150</td>
<td>300</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( t_{\text{PDLH}} )</td>
<td></td>
<td>( V_{DD} = 10\text{V} )</td>
<td>65</td>
<td>150</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( t_{\text{PDLH}} )</td>
<td></td>
<td>( V_{DD} = 15\text{V} )</td>
<td>45</td>
<td>90</td>
<td>ns</td>
<td></td>
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<tr>
<td>( t_{\text{SET}} - t_{\text{HST}} )</td>
<td>Minimum Set and Reset Pulse Width</td>
<td>( V_{DD} = 5\text{V} )</td>
<td>90</td>
<td>180</td>
<td>ns</td>
<td></td>
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<tr>
<td>( t_{\text{SET}} - t_{\text{HST}} )</td>
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<td>( V_{DD} = 10\text{V} )</td>
<td>40</td>
<td>80</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( t_{\text{SET}} - t_{\text{HST}} )</td>
<td></td>
<td>( V_{DD} = 15\text{V} )</td>
<td>25</td>
<td>50</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( C_{\text{IN}} )</td>
<td>Average Input Capacitance</td>
<td>Any Input</td>
<td>5</td>
<td>7.5</td>
<td>pF</td>
<td></td>
</tr>
</tbody>
</table>

Note 5: AC Parameters are guaranteed by DC correlated testing.

### Switching Time Waveforms

![Switching Time Waveforms](image-url)
Physical Dimensions

14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow
Package Number M14A

14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
Package Number M14D
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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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