National Semiconductor

# CD4015BM/CD4015BC Dual 4-Bit Static Shift Register

## General Description

The CD4015BM/CD4015BC contains two identical, 4-stage, serial-input/parallel-output registers with independent "Data", "Clock," and "Reset" inputs. The logic level present at the input of each stage is transferred to the output of that stage at each positive-going clock transition. A logic high on the "Reset" input resets all four stages covered by that input. All inputs are protected from static discharge by a series resistor and diode clamps to $V_{DD}$ and $V_{SS}$.

## Features

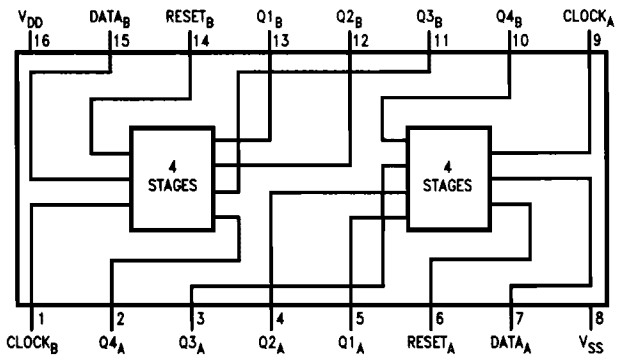
| | |
|---|---|
| ■ Wide supply voltage range | 3.0V to 18V |
| ■ High noise immunity | 0.45 $V_{DD}$ (typ.) |
| ■ Low power TTL compatibility | Fan out of 2 driving 74L or 1 driving 74LS |
| ■ Medium speed operation | 8 MHz (typ.) clock rate |
| ■ Fully static design | @$V_{DD} - V_{SS} = 10V$ |

## Applications

- Serial-input/parallel-output data queueing
- Serial to parallel data conversion
- General purpose register

## Connection Diagram and Truth Table

**Dual-In-Line Package**

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| CL▲ | D | R | $Q_1$ | $Q_n$ | |
|---|---|---|---|---|---|
| ⌐ | 0 | 0 | 0 | $Q_{n-1}$ | |
| ⌐ | 1 | 0 | 1 | $Q_{n-1}$ | |
| ¬ | X | 0 | $Q_1$ | $Q_n$ | (No change) |
| X | X | 1 | 0 | 0 | |

▲ Level change

X = Don't care case

**Order Number CD4015B***

*Please look into Section 8, Appendix D for availability of various package types.

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## Absolute Maximum Ratings (Notes 1 & 2)

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

| | |
|---|---|
| DC Supply Voltage ($V_{DD}$) | $-0.5$ to $+18$ $V_{DC}$ |
| Input Voltage ($V_{IN}$) | $-0.5$ to $V_{DD}+0.5$ $V_{DC}$ |
| Storage Temperature Range ($T_S$) | $-65°C$ to $+150°C$ |
| 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

| | |
|---|---|
| DC Supply Voltage ($V_{DD}$) | $+3$ to $+15$ $V_{DC}$ |
| Input Voltage ($V_{IN}$) | 0 to $V_{DD}$ $V_{DC}$ |
| Operating Temperature Range ($T_A$) | |
| CD4015BM | $-55°C$ to $+125°C$ |
| CD4015BC | $-40°C$ to $+85°C$ |

## DC Electrical Characteristics CD4015BM (Note 2)

| Symbol | Parameter | Conditions | −55°C | | +25°C | | | +125°C | | Units |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Max | Min | Typ | Max | Min | Max | |
| $I_{DD}$ | Quiescent Device Current | $V_{DD}=5V$, $V_{IN}=V_{DD}$ or $V_{SS}$ | | 5 | | 0.005 | 5 | | 150 | μA |
| | | $V_{DD}=10V$, $V_{IN}=V_{DD}$ or $V_{SS}$ | | 10 | | 0.010 | 10 | | 300 | μA |
| | | $V_{DD}=15V$, $V_{IN}=V_{DD}$ or $V_{SS}$ | | 20 | | 0.015 | 20 | | 600 | μA |
| $V_{OL}$ | Low Level Output Voltage | $V_{DD}=5V$ } $\lvert I_O\rvert < 1\ \mu A$ | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| | | $V_{DD}=10V$ } $\lvert I_O\rvert < 1\ \mu A$ | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| | | $V_{DD}=15V$ } $\lvert I_O\rvert < 1\ \mu A$ | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| $V_{OH}$ | High Level Output Voltage | $V_{DD}=5V$ } $\lvert I_O\rvert < 1\ \mu A$ | 4.95 | | 4.95 | 5 | | 4.95 | | V |
| | | $V_{DD}=10V$ } $\lvert I_O\rvert < 1\ \mu A$ | 9.95 | | 9.95 | 10 | | 9.95 | | V |
| | | $V_{DD}=15V$ } $\lvert I_O\rvert < 1\ \mu A$ | 14.95 | | 14.95 | 15 | | 14.95 | | V |
| $V_{IL}$ | Low Level Input Voltage | $V_{DD}=5V$, $V_O=0.5V$ or $4.5V$ | | 1.5 | | 2.25 | 1.5 | | 1.5 | V |
| | | $V_{DD}=10V$, $V_O=1.0V$ or $9.0V$ | | 3.0 | | 4.50 | 3.0 | | 3.0 | V |
| | | $V_{DD}=15V$, $V_O=1.5V$ or $13.5V$ | | 4.0 | | 6.75 | 4.0 | | 4.0 | V |
| $V_{IH}$ | High Level Input Voltage | $V_{DD}=5V$, $V_O=0.5V$ or $4.5V$ | 3.5 | | 3.5 | 2.75 | | 3.5 | | V |
| | | $V_{DD}=10V$, $V_O=1.0V$ or $9.0V$ | 7.0 | | 7.0 | 5.50 | | 7.0 | | V |
| | | $V_{DD}=15V$, $V_O=1.5V$ or $13.5V$ | 11.0 | | 11.0 | 8.25 | | 11.0 | | V |
| $I_{OL}$ | Low Level Output Current (Note 3) | $V_{DD}=5V$, $V_O=0.4V$ | 0.64 | | 0.51 | 0.88 | | 0.36 | | mA |
| | | $V_{DD}=10V$, $V_O=0.5V$ | 1.6 | | 1.3 | 2.25 | | 0.9 | | mA |
| | | $V_{DD}=15V$, $V_O=1.5V$ | 4.2 | | 3.4 | 8.8 | | 2.4 | | mA |
| $I_{OH}$ | High Level Output Current (Note 3) | $V_{DD}=5V$, $V_O=4.6V$ | −0.64 | | −0.51 | −0.88 | | −0.36 | | mA |
| | | $V_{DD}=10V$, $V_O=9.5V$ | −1.6 | | −1.3 | −2.25 | | −0.9 | | mA |
| | | $V_{DD}=15V$, $V_O=13.5V$ | −4.2 | | −3.4 | −8.8 | | −2.4 | | mA |
| $I_{IN}$ | Input Current | $V_{DD}=15V$, $V_{IN}=0V$ | | −0.1 | | $-10^{-5}$ | −0.1 | | −1.0 | μA |
| | | $V_{DD}=15V$, $V_{IN}=15V$ | | 0.1 | | $10^{-5}$ | 0.1 | | 1.0 | μA |

**Note 1:** "Absolute Maximum Ratings" are those 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 2:** $V_{SS}$ = 0V unless otherwise specified.

**Note 3:** $I_{OH}$ and $I_{OL}$ are tested one output at a time.

## DC Electrical Characteristics CD4015BC (Note 2)

| Symbol | Parameter | Conditions | −55°C | | +25°C | | | +125°C | | Units |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Max | Min | Typ | Max | Min | Max | |
| $I_{DD}$ | Quiescent Device Current | $V_{DD}$ = 5V, $V_{IN}$ = $V_{DD}$ or $V_{SS}$ | | 20 | | 0.005 | 20 | | 150 | μA |
| | | $V_{DD}$ = 10V, $V_{IN}$ = $V_{DD}$ or $V_{SS}$ | | 40 | | 0.010 | 40 | | 300 | μA |
| | | $V_{DD}$ = 15V, $V_{IN}$ = $V_{DD}$ or $V_{SS}$ | | 80 | | 0.015 | 80 | | 600 | μA |
| $V_{OL}$ | Low Level Output Voltage | $V_{DD}$ = 5V | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| | | $V_{DD}$ = 10V | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| | | $V_{DD}$ = 15V | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| $V_{OH}$ | High Level Output Voltage | $V_{DD}$ = 5V | 4.95 | | 4.95 | 5 | | 4.95 | | V |
| | | $V_{DD}$ = 10V | 9.95 | | 9.95 | 10 | | 9.95 | | V |
| | | $V_{DD}$ = 15V | 14.95 | | 14.95 | 15 | | 14.95 | | V |
| $V_{IL}$ | Low Level Input Voltage | $V_{DD}$ = 5V, $V_O$ = 0.5V or 4.5V | | 1.5 | | 2.25 | 1.5 | | 1.5 | V |
| | | $V_{DD}$ = 10V, $V_O$ = 1.0V or 9.0V | | 3.0 | | 4.50 | 3.0 | | 3.0 | V |
| | | $V_{DD}$ = 15V, $V_O$ = 1.5V or 13.5V | | 4.0 | | 6.75 | 4.0 | | 4.0 | V |
| $V_{IH}$ | High Level Input Voltage | $V_{DD}$ = 5V, $V_O$ = 0.5V or 4.5V | 3.5 | | 3.5 | 2.75 | | 3.5 | | V |
| | | $V_{DD}$ = 10V, $V_O$ = 1.0V or 9.0V | 7.0 | | 7.0 | 5.50 | | 7.0 | | V |
| | | $V_{DD}$ = 15V, $V_O$ = 1.5V or 13.5V | 11.0 | | 11.0 | 8.25 | | 11.0 | | V |
| $I_{OL}$ | Low Level Output Current (Note 3) | $V_{DD}$ = 5V, $V_O$ = 0.4V | 0.52 | | 0.44 | 0.88 | | 0.36 | | mA |
| | | $V_{DD}$ = 10V, $V_O$ = 0.5V | 1.3 | | 1.1 | 2.25 | | 0.9 | | mA |
| | | $V_{DD}$ = 15V, $V_O$ = 1.5V | 3.6 | | 3.0 | 8.8 | | 2.4 | | mA |
| $I_{OH}$ | High Level Output Current (Note 3) | $V_{DD}$ = 5V, $V_O$ = 4.6V | −0.52 | | −0.44 | −0.88 | | −0.36 | | mA |
| | | $V_{DD}$ = 10V, $V_O$ = 9.5V | −1.3 | | −1.1 | −2.25 | | −0.9 | | mA |
| | | $V_{DD}$ = 15V, $V_O$ = 13.5V | −3.6 | | −3.0 | −8.8 | | −2.4 | | mA |
| $I_{IN}$ | Input Current | $V_{DD}$ = 15V, $V_{IN}$ = 0V | | −0.3 | | $-10^{-5}$ | −0.3 | | −1.0 | μA |
| | | $V_{DD}$ = 15V, $V_{IN}$ = 15V | | 0.3 | | $10^{-5}$ | 0.3 | | 1.0 | μA |

**Note 1:** "Absolute Maximum Ratings" are those 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 2:** $V_{SS}$ = 0V unless otherwise specified.

**Note 3:** $I_{OH}$ and $I_{OL}$ are tested one output at a time.

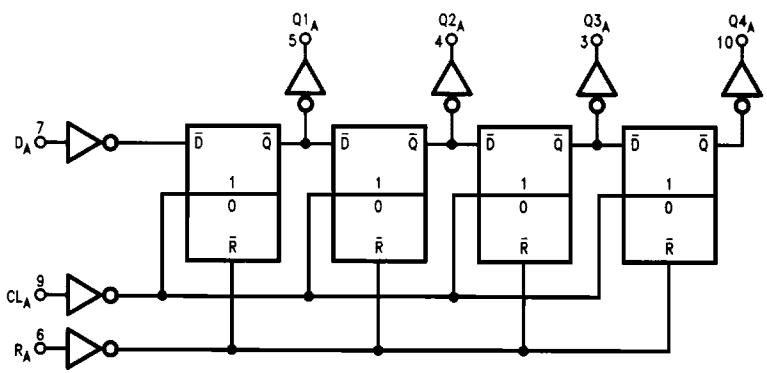
## AC Electrical Characteristics*

$T_A$ = 25°C, $C_L$ = 50 pF, $R_L$ = 200k, $t_r$ = $t_f$ = 20 ns, unless otherwise specified

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **CLOCK OPERATION** | | | | | | |
| $t_{PHL}$, $t_{PLH}$ | Propagation Delay Time | $V_{DD}$ = 5V | | 230 | 350 | ns |
| | | $V_{DD}$ = 10V | | 80 | 160 | ns |
| | | $V_{DD}$ = 15V | | 60 | 120 | ns |
| $t_{THL}$, $t_{TLH}$ | Transition Time | $V_{DD}$ = 5V | | 100 | 200 | ns |
| | | $V_{DD}$ = 10V | | 50 | 100 | ns |
| | | $V_{DD}$ = 15V | | 40 | 80 | ns |
| $t_{WL}$, $t_{WM}$ | Minimum Clock Pulse-Width | $V_{DD}$ = 5V | | 160 | 250 | ns |
| | | $V_{DD}$ = 10V | | 60 | 110 | ns |
| | | $V_{DD}$ = 15V | | 50 | 85 | ns |
| $t_{rCL}$, $t_{fCL}$ | Clock Rise and Fall Time | $V_{DD}$ = 5V | | | 15 | μs |
| | | $V_{DD}$ = 10V | | | 15 | μs |
| | | $V_{DD}$ = 15V | | | 15 | μs |
| $t_{SU}$ | Minimum Data Set-Up Time | $V_{DD}$ = 5V | | 50 | 100 | μs |
| | | $V_{DD}$ = 10V | | 20 | 40 | μs |
| | | $V_{DD}$ = 15V | | 15 | 30 | μs |
| $f_{CL}$ | Maximum Clock Frequency | $V_{DD}$ = 5V | 2 | 3.5 | | MHz |
| | | $V_{DD}$ = 10V | 4.5 | 8 | | MHz |
| | | $V_{DD}$ = 15V | 6 | 11 | | MHz |
| $C_{IN}$ | Input Capacitance | Clock Input | | 7.5 | 10 | pF |
| | | Other Inputs | | 5 | 7.5 | pF |
| **RESET OPERATION** | | | | | | |
| $t_{PHL(R)}$ | Propagation Delay Time | $V_{DD}$ = 5V | | 200 | 400 | ns |
| | | $V_{DD}$ = 10V | | 100 | 200 | ns |
| | | $V_{DD}$ = 15V | | 80 | 160 | ns |
| $t_{WH(R)}$ | Minimum Reset Pulse Width | $V_{DD}$ = 5V | | 135 | 250 | ns |
| | | $V_{DD}$ = 10V | | 40 | 80 | ns |
| | | $V_{DD}$ = 15V | | 30 | 60 | ns |

*AC Parameters are guaranteed by DC correlated testing.

## Logic Diagrams

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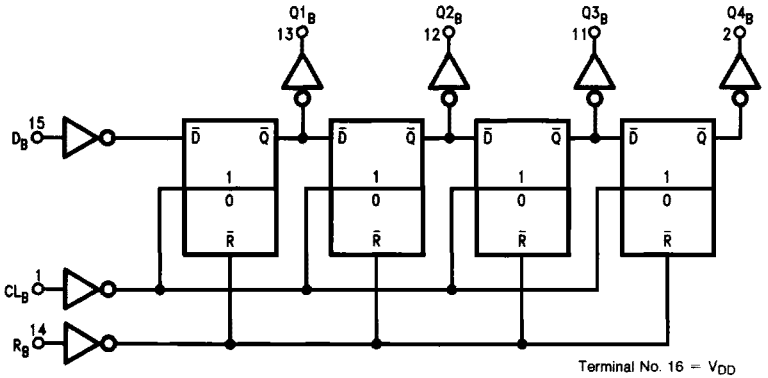
## Logic Diagrams (Continued)




Terminal No. 16 = $V_{DD}$
Terminal No. 8 = GND

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