

**CD4020BM/CD4020BC 14-Stage Ripple Carry
Binary Counters**
**CD4040BM/CD4040BC 12-Stage Ripple Carry
Binary Counters**
**CD4060BM/CD4060BC 14-Stage Ripple Carry
Binary Counters**

General Description

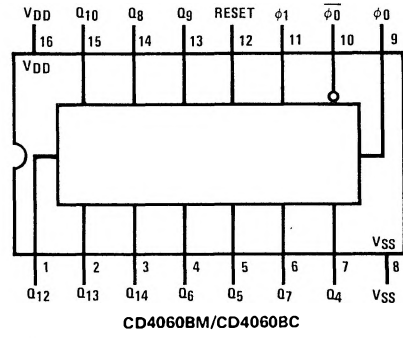
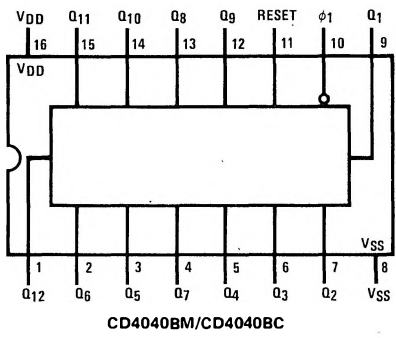
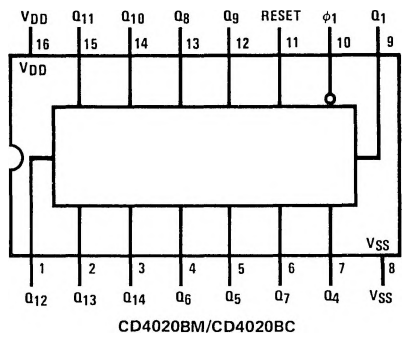
The CD4020BM/CD4020BC, CD4060BM/CD4060BC are 14-stage ripple carry binary counters, and the CD4040BM/CD4040BC is a 12-stage ripple carry binary counter. The counters are advanced one count on the negative transition of each clock pulse. The counters are reset to the zero state by a logical "1" at the reset input independent of clock.

Features

- Wide supply voltage range 1.0V to 15V
- High noise immunity 0.45V_{DD} (typ.)
- Low power TTL compatibility fan out of 2 driving 74L
or 1 driving 74LS
- Medium speed operation 8 MHz typ. at V_{DD} = 10V
- Schmitt trigger clock input

Connection Diagrams

TOP VIEW



Absolute Maximum Ratings (Notes 1 and 2)

| | | |
|-----------------|--|---------------------------------|
| V _{DD} | Supply Voltage | -0.5V to +18V |
| V _{IN} | Input Voltage | -0.5V to V _{DD} + 0.5V |
| T _S | Storage Temperature Range | -65°C to +150°C |
| P _D | Package Dissipation | 500mW |
| T _L | Lead Temperature (soldering, 10 seconds) | 300°C |

Recommended Operating Conditions

| | | |
|-----------------|-----------------------------|-----------------------|
| V _{DD} | Supply Voltage | +3V to +15V |
| V _{IN} | Input Voltage | 0V to V _{DD} |
| T _A | Operating Temperature Range | |
| | CD40XXBM | -55°C to +125°C |
| | CD40XXBC | -40°C to +85°C |

DC Electrical Characteristics CD40XXBM (Note 2)

| PARAMETER | CONDITIONS | -55°C | | +25°C | | +125°C | | UNITS | |
|---|---|-------|-------|-------|-------------------|--------|-------|-------|-----|
| | | MIN | MAX | MIN | TYP | MAX | MIN | | MAX |
| I _{DD} Quiescent Device Current | V _{DD} = 5V | | 5 | | | 5 | | 150 | μA |
| | V _{DD} = 10V | | 10 | | | 10 | | 300 | μA |
| | V _{DD} = 15V | | 20 | | | 20 | | 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 | 1.5 | | 1.5 | V |
| | V _{DD} = 10V, V _O = 1.0V or 9.0V | | 3.0 | | 4 | 3.0 | | 3.0 | V |
| | V _{DD} = 15V, V _O = 1.5V or 13.5V | | 4.0 | | 6 | 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 | 3 | | 3.5 | | V |
| | V _{DD} = 10V, V _O = 1.0V or 9.0V | 7.0 | | 7.0 | 6 | | 7.0 | | V |
| | V _{DD} = 15V, V _O = 1.5V or 13.5V | 11.0 | | 11.0 | 9 | | 11.0 | | V |
| I _{OL} Low Level Output Current (See 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 (See 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 | | -0.10 | | -10 ⁻⁵ | -0.10 | | -1.0 | μA |
| | V _{DD} = 15V, V _{IN} = 15V | | 0.10 | | 10 ⁻⁵ | 0.10 | | 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: Data does not apply to oscillator points φ₀ and φ̄₀ of CD4060BM/CD4060BC.

DC Electrical Characteristics 40XXBC (Note 2)

| PARAMETER | CONDITIONS | -40°C | | +25°C | | | +85°C | | UNITS |
|--|---------------------------------------|-------|-------|-------|---------|-------|-------|------|---------|
| | | MIN | MAX | MIN | TYP | MAX | MIN | MAX | |
| I_{DD} Quiescent Device Current | $V_{DD} = 5V$ | | 20 | | | 20 | | 150 | μA |
| | $V_{DD} = 10V$ | | 40 | | | 40 | | 300 | μA |
| | $V_{DD} = 15V$ | | 80 | | | 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 | 1.5 | | 1.5 | V |
| | $V_{DD} = 10V, V_O = 1.0V$ or $9.0V$ | | 3.0 | | 4 | 3.0 | | 3.0 | V |
| | $V_{DD} = 15V, V_O = 1.5V$ or $13.5V$ | | 4.0 | | 6 | 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 | 3 | | 3.5 | | V |
| | $V_{DD} = 10V, V_O = 1.0V$ or $9.0V$ | 7.0 | | 7.0 | 6 | | 7.0 | | V |
| | $V_{DD} = 15V, V_O = 1.5V$ or $13.5V$ | 11.0 | | 11.0 | 9 | | 11.0 | | V |
| I_{OL} Low Level Output Current (See 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 (See 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 | | -3.6 | -8.8 | | -2.4 | | mA |
| I_{IN} Input Current | $V_{DD} = 15V, V_{IN} = 0V$ | | -0.30 | | -10^5 | -0.30 | | -1.0 | μA |
| | $V_{DD} = 15V, V_{IN} = 15V$ | | 0.30 | | 10^5 | 0.30 | | 1.0 | μA |

AC Electrical Characteristics CD4020BM/CD4020BC, CD4040BM/CD4040BC

$T_A = 25^\circ C, C_L = 50pF, R_L = 200k, t_r = t_f = 20ns$, unless otherwise noted.

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|--------------------|-----|-----|----------|-------|
| t_{PHL1}, t_{PLH1} Propagation Delay Time to Q_1 | $V_{DD} = 5V$ | | 250 | 550 | ns |
| | $V_{DD} = 10V$ | | 100 | 210 | ns |
| | $V_{DD} = 15V$ | | 75 | 150 | ns |
| t_{PHL}, t_{PLH} Interstage Propagation Delay Time from Q_n to Q_{n+1} | $V_{DD} = 5V$ | | 150 | 330 | ns |
| | $V_{DD} = 10V$ | | 60 | 125 | ns |
| | $V_{DD} = 15V$ | | 45 | 90 | ns |
| t_{THL}, t_{TLH} Transition Time | $V_{DD} = 5V$ | | 100 | 200 | ns |
| | $V_{CD} = 10V$ | | 50 | 100 | ns |
| | $V_{DD} = 15V$ | | 40 | 80 | ns |
| t_{WL}, t_{WH} Minimum Clock Pulse Width | $V_{DD} = 5V$ | | 125 | 335 | ns |
| | $V_{DD} = 10V$ | | 50 | 125 | ns |
| | $V_{DD} = 15V$ | | 40 | 100 | ns |
| t_{CL}, t_{CFL} Maximum Clock Rise and Fall Time | $V_{DD} = 5V$ | | | no limit | ns |
| | $V_{DD} = 10V$ | | | no limit | ns |
| | $V_{DD} = 15V$ | | | no limit | ns |
| f_{CL} Maximum Clock Frequency | $V_{DD} = 5V$ | 1.5 | 4 | | MHz |
| | $V_{DD} = 10V$ | 4 | 10 | | MHz |
| | $V_{DD} = 15V$ | 5 | 12 | | MHz |
| $t_{PHL(R)}$ Reset Propagation Delay | $V_{DD} = 5V$ | | 200 | 450 | ns |
| | $V_{DD} = 10V$ | | 100 | 210 | ns |
| | $V_{DD} = 15V$ | | 80 | 170 | ns |
| $t_{WH(R)}$ Minimum Reset Pulse Width | $V_{DD} = 5V$ | | 200 | 450 | ns |
| | $V_{DD} = 10V$ | | 100 | 210 | ns |
| | $V_{DD} = 15V$ | | 80 | 170 | ns |
| C_{in} Average Input Capacitance | Any Input (Note 1) | | 5 | 7.5 | pF |
| C_{pd} Power Dissipation Capacitance | (Note 2) | | 50 | | pF |

Note 1: Capacitance guaranteed by periodic testing.

Note 2: C_{pd} determines the no-load etc.

CD4020BM/CD4020BC, CD4040BM/CD4040BC, CD4060BM/CD4060BC

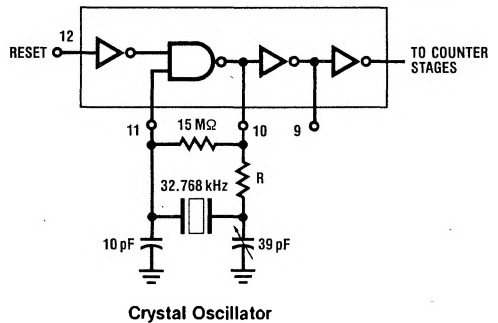
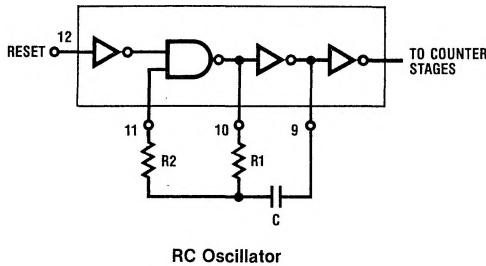
AC Electrical Characteristics CD4060BM/CD4060BC $T_A = 25^\circ\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ k}$, $t_r = t_f = 20\text{ ns}$, unless otherwise noted

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|-------------------------|---|-------------|-------------------|----------------------------------|-------------------|
| t_{PHL4} , t_{PLH4} | Propagation Delay Time to Q_4 $V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$ | | 550 250 200 | 1300 525 400 | ns |
| t_{PHL} , t_{PLH} | Interstage Propagation Delay Time from Q_n to Q_{n+1} $V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$ | | 150 60 45 | 330 125 90 | ns |
| t_{THL} , t_{TLH} | Transition Time $V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$ | | 100 50 40 | 200 100 80 | ns |
| t_{WL} , t_{WH} | Minimum Clock Pulse Width $V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$ | | 170 65 50 | 500 170 125 | ns |
| t_{rCL} , t_{fCL} | Maximum Clock Rise and Fall Time $V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$ | | | no limit no limit no limit | ns |
| f_{CL} | Maximum Clock Frequency $V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$ | 1 3 4 | 3 8 10 | | MHz MHz MHz |
| $t_{PHL(R)}$ | Reset Propagation Delay $V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$ | | 200 100 80 | 450 210 170 | ns |
| $t_{WH(R)}$ | Minimum Reset Pulse Width $V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$ | | 200 100 80 | 450 210 170 | ns |
| C_{in} | Average Input Capacitance Any Input (Note 1) | | 5 | 7.5 | pF |
| C_{pd} | Power Dissipation Capacitance (Note 2) | | 50 | | pF |

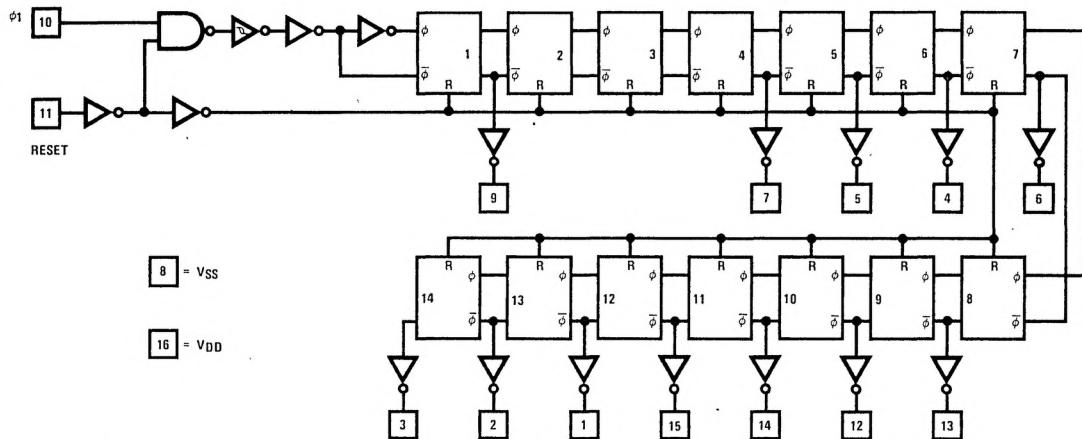
Note 1: Capacitance guaranteed by periodic testing.

Note 2: C_{pd} determines the no-load etc.

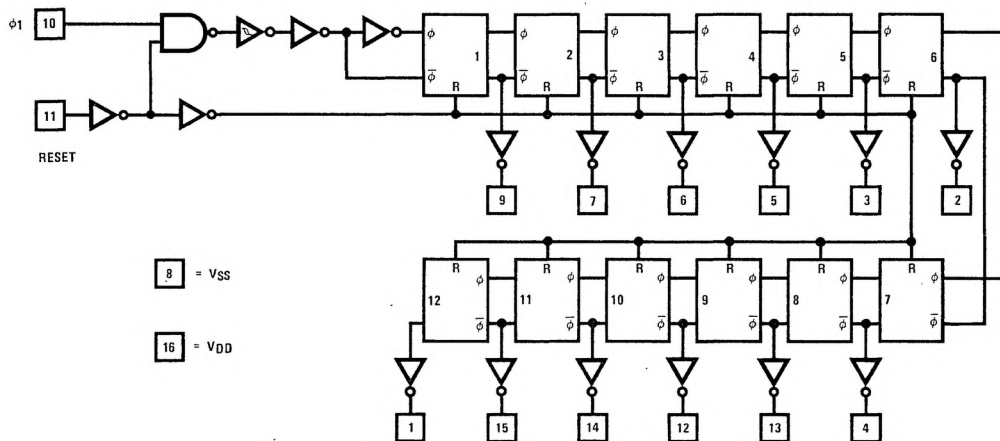
CD4060B Typical Oscillator Connections



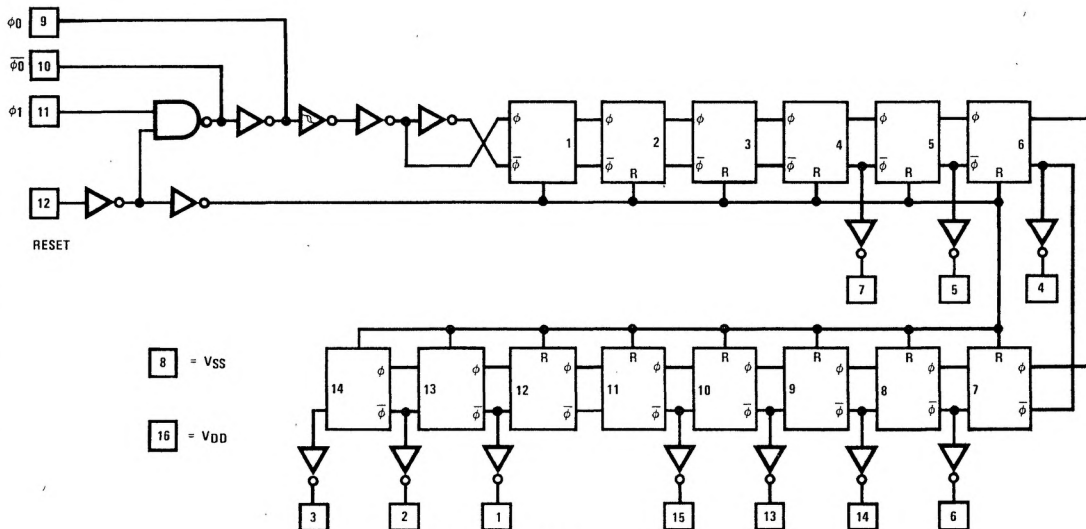
Schematic Diagrams



CD4020BM/CD4020BC Schematic Diagram



CD4040BM/CD4040BC Schematic Diagram



CD4060BM/CD4060BC Schematic Diagram