

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

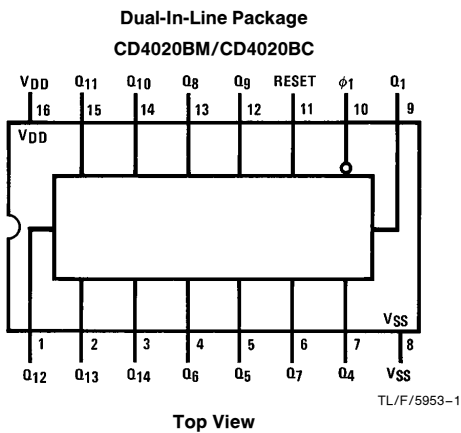
General Description

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.

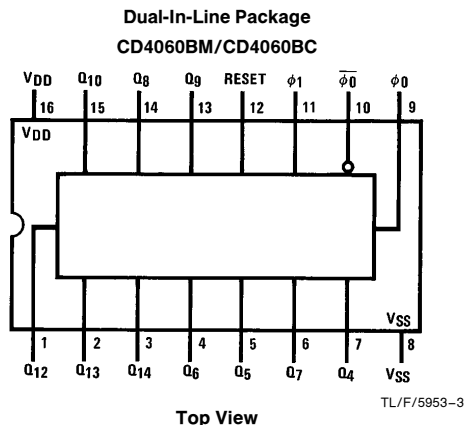
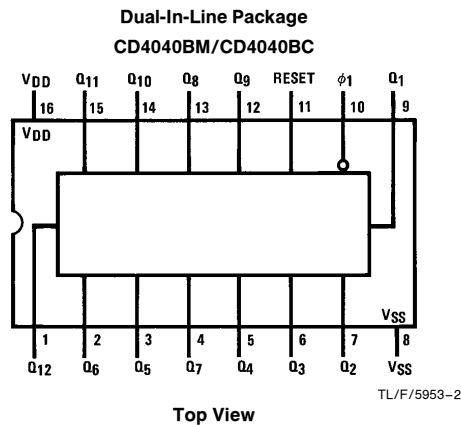
Features

- Wide supply voltage range 1.0V to 15V
- High noise immunity 0.45 V_{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



Order Number CD4020B, CD4040B or CD4060B



CD4020BM/BC 14-Stage Ripple Carry Binary Counters/CD4040BM/BC 12-Stage Ripple Carry Binary Counters CD4060BM/BC 14-Stage Ripple Carry Binary Counters

Absolute Maximum Ratings (Notes 1 and 2)

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

| | |
|-------------------------------------|--------------------------|
| Supply Voltage (V_{DD}) | -0.5V to +18V |
| Input Voltage (V_{IN}) | -0.5V to V_{DD} + 0.5V |
| Storage Temperature Range (T_S) | -65°C to +150°C |
| Package Dissipation (P_D) | |
| Dual-In-Line | 700 mW |
| Small Outline | 500 mW |
| Lead Temperature (T_L) | |
| (Soldering, 10 seconds) | 260°C |

Recommended Operating Conditions

| | |
|---------------------------------------|-----------------|
| Supply Voltage (V_{DD}) | +3V to +15V |
| Input Voltage (V_{IN}) | 0V to V_{DD} |
| Operating Temperature Range (T_A) | |
| CD40XXBM | -55°C to +125°C |
| CD40XXBC | -40°C to +85°C |

DC Electrical Characteristics CD40XXBM (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 | | | 5 | | 150 | μA |
| | | $V_{DD} = 10V, V_{IN} = V_{DD}$ or V_{SS} | | 10 | | | 10 | | 300 | μA |
| | | $V_{DD} = 15V, V_{IN} = V_{DD}$ or V_{SS} | | 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 ϕ_0 and $\overline{\phi_0}$ of CD4060BM/CD4060BC. I_{OH} and I_{OL} are tested one output at a time.

DC Electrical Characteristics 40XXBC (Note 2)

| Symbol | Parameter | Conditions | -40°C | | +25°C | | | +85°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 | | | 20 | | 150 | μA |
| | | $V_{DD} = 10V, V_{IN} = V_{DD}$ or V_{SS} | | 40 | | | 40 | | 300 | μA |
| | | $V_{DD} = 15V, V_{IN} = V_{DD}$ or V_{SS} | | 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 |

DC Electrical Characteristics 40XXBC (Note 2) (Continued)

| Symbol | Parameter | Conditions | -40°C | | +25°C | | | +85°C | | Units |
|-----------------|-------------------------------------------|---------------------------------------------------------------------------------------------|-------|---------------|-------|---------------------------------------|---------------|-------|-------------|-------|
| | | | Min | Max | Min | Typ | Max | Min | Max | |
| 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 | | -3.0 | -8.8 | | -2.4 | | mA |
| I _{IN} | Input Current | V _{DD} = 15V, V _{IN} = 0V V _{DD} = 15V, V _{IN} = 15V | | -0.30 0.30 | | -10 ⁻⁵ 10 ⁻⁵ | -0.30 0.30 | | -1.0 1.0 | μA |

AC Electrical Characteristics* CD4020BM/CD4020BC, CD4040BM/CD4040BC

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

| Symbol | 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 _{DD} = 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 _{rCL} , t _{fCL} | 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 | | 5 | 7.5 | pF |
| C _{pd} | Power Dissipation Capacitance | | | 50 | | pF |

*AC Parameters are guaranteed by DC correlated testing.

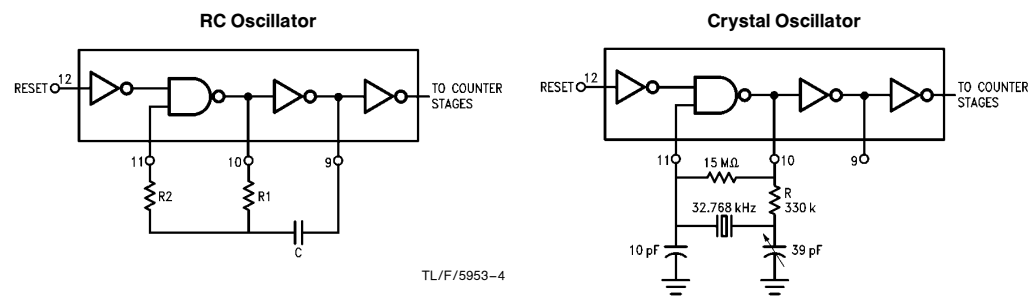
AC Electrical Characteristics* CD4060BM/CD4060BC

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

| Symbol | 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 ns 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 ns 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 ns 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 ns 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 ns 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 ns 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 ns ns |
| C_{in} | Average Input Capacitance | Any Input | | 5 | 7.5 | pF |
| C_{pd} | Power Dissipation Capacitance | | | 50 | | pF |

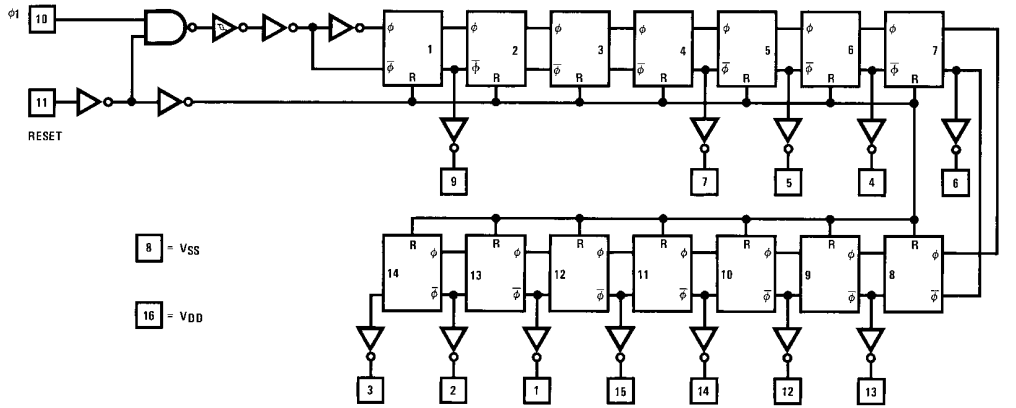
*AC Parameters are guaranteed by DC correlated testing.

CD4060B Typical Oscillator Connections

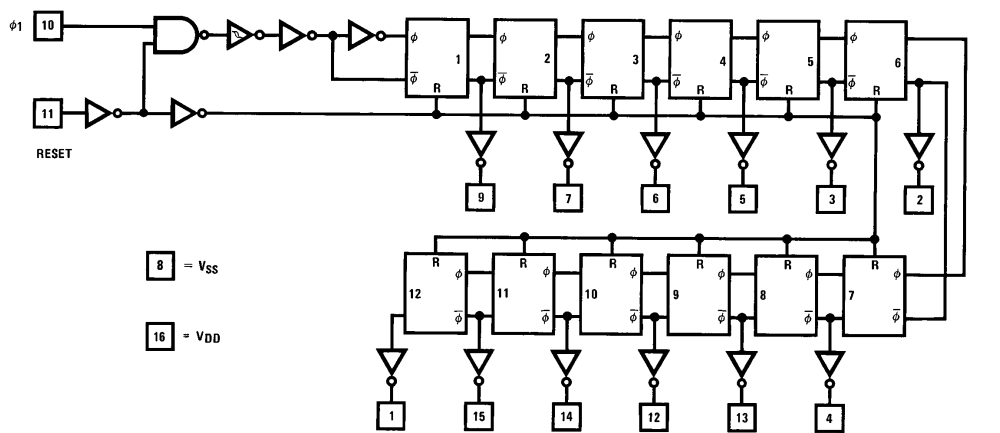


Schematic Diagrams

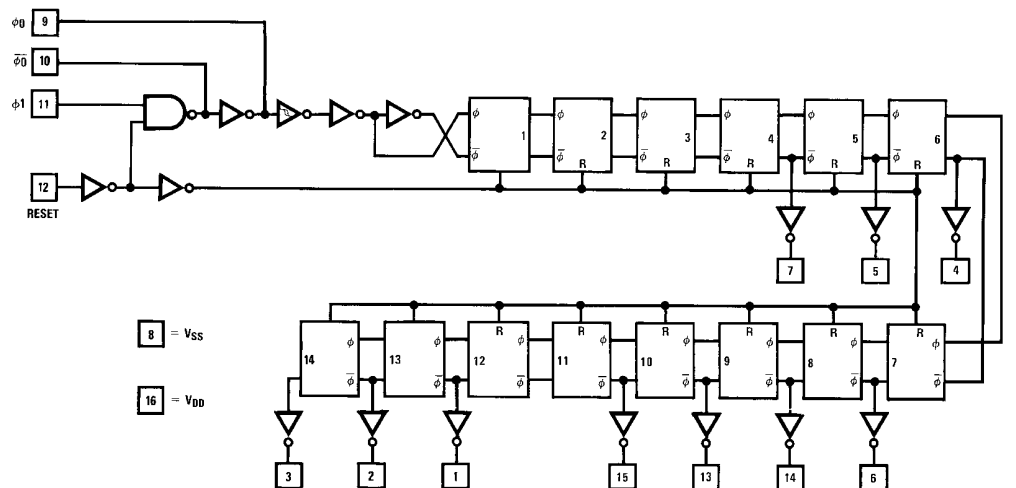
CD4020BM/CD4020BC Schematic Diagram



CD4040BM/CD4040BC Schematic Diagram

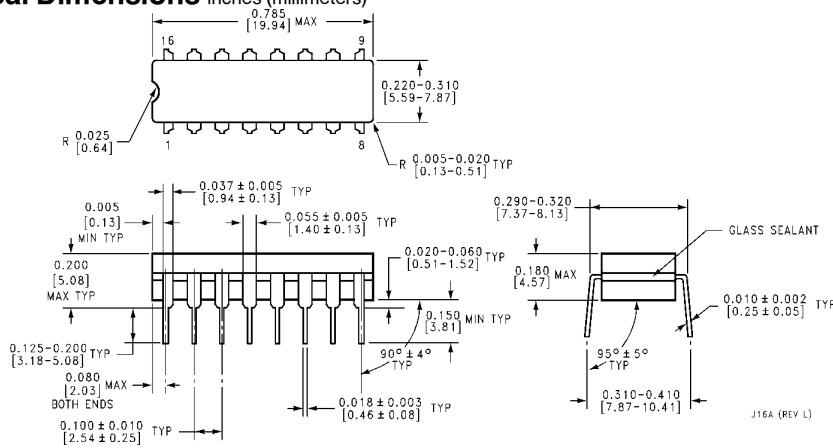


CD4060BM/CD4060BC Schematic Diagram

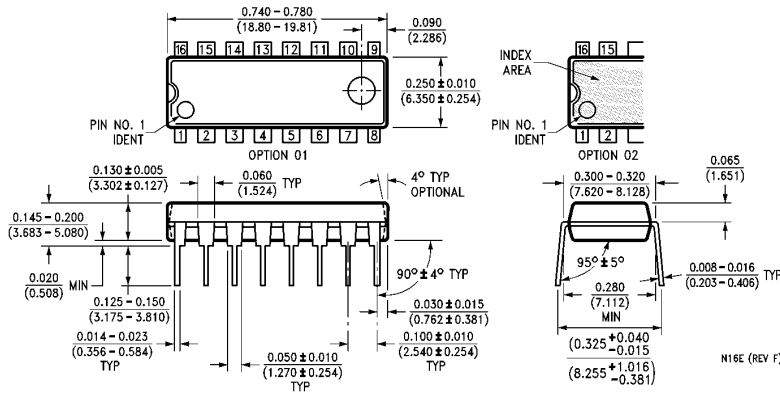


CD4020BM/BC 14-Stage Ripple Carry Binary Counters/CD4040BM/BC 12-Stage Ripple Carry Binary Counters
CD4060BM/BC 14-Stage Ripple Carry Binary Counters

Physical Dimensions inches (millimeters)



Ceramic Dual-In-Line Package (J)
Order Number CD4020BMJ, CD4020BCJ,
CD4040BMJ, CD4040BCJ, CD4060BMJ or CD4060BCJ
NS Package Number J16A



Molded Dual-In-Line Package (N)
Order Number CD4020BMN, CD4020BCN,
CD4040BMN, CD4040BCN, CD4060BMN or CD4060BCN
NS Package Number N16E

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