

## CD4035BM/CD4035BC 4-Bit Parallel-In/Parallel-Out Shift Register

### General Description

The CD4035B 4-bit parallel-in/parallel-out shift register is a monolithic complementary MOS (CMOS) integrated circuit constructed with P- and N-channel enhancement mode transistors. This shift register is a 4-stage clocked serial register having provisions for synchronous parallel inputs to each stage and serial inputs to the first stage via JK logic. Register stages 2, 3, and 4 are coupled in a serial "D" flip-flop configuration when the register is in the serial mode (parallel/serial control low).

Parallel entry via the "D" line of each register stage is permitted only when the parallel/serial control is "high".

In the parallel or serial mode, information is transferred on positive clock transitions.

When the true/complement control is "high", the true contents of the register are available at the output terminals. When the true/complement control is "low", the outputs are the complements of the data in the register. The true/complement control functions asynchronously with respect to the clock signal.

JK input logic is provided on the first stage serial input to minimize logic requirements particularly in counting and sequence-generation applications. With JK inputs connected together, the first stage becomes a "D" flip-flop. An asynchronous common reset is also provided.

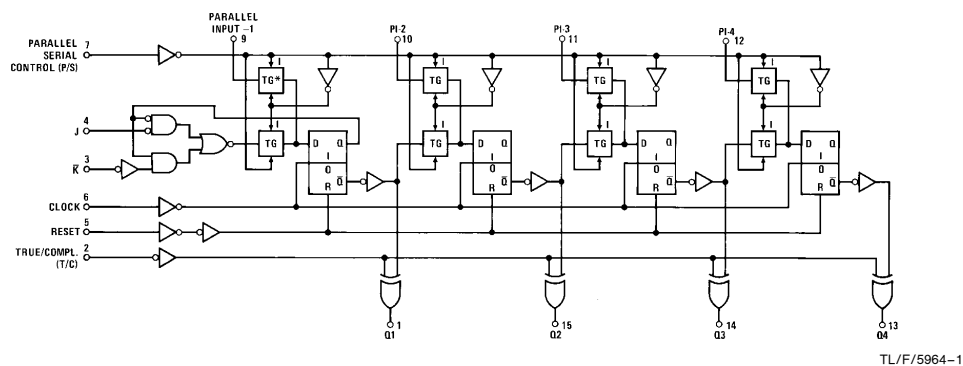
### Features

- Wide supply voltage range 3.0V to 15V
- High noise immunity 0.45 V<sub>DD</sub> (typ.)
- Low power TTL compatibility Fan out of 2 driving 74L or 1 driving 74LS
- 4-stage clocked operation
- Synchronous parallel entry on all 4 stages
- JK inputs on first stage
- Asynchronous true/complement control on all outputs
- Reset control
- Static flip-flop operation; master/slave configuration
- Buffered outputs
- Low power dissipation 5  $\mu$ W (typ.) (ceramic) to 5 mW
- High speed to 5 MHz

### Applications

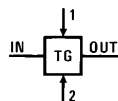
- Automotive
- Data terminals
- Instrumentation
- Medical electronics
- Alarm systems
- Industrial controls
- Remote metering
- Computers

### Logic Diagram



P/S = 0 = serial mode  
T/C = 1 = true outputs  
\*TG = transmission gate

Input to output is:  
a) A bidirectional low impedance when control input 1 is low and control input 2 is high.  
b) An open circuit when control input 1 is high and control input 2 is low.



TL/F/5964-2

**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.

|                                     |                          |
|-------------------------------------|--------------------------|
| DC 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          |
| Power Dissipation ( $P_D$ )         |                          |
| Dual-In-Line                        | 700 mW                   |
| Small Outline                       | 500 mW                   |

Lead Temperature ( $T_L$ )  
(Soldering, 10 seconds)

260°C

**Operating Conditions** (Note 2)

|                                       |                  |
|---------------------------------------|------------------|
| DC Supply Voltage ( $V_{DD}$ )        | 3V to 15V        |
| Input Voltage ( $V_{IN}$ )            | 0V to $V_{DD}$ V |
| Operating Temperature Range ( $T_A$ ) |                  |
| CD4035BM                              | −55°C to +125°C  |
| CD4035BC                              | −40°C to +85°C   |

**DC Electrical Characteristics** CD4035BM (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    |       | 0.3        | 5    |        | 150  | $\mu A$ |
|          |                                    | $V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$ |       | 10   |       | 0.5        | 10   |        | 300  | $\mu A$ |
|          |                                    | $V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$ |       | 20   |       | 1.0        | 20   |        | 600  | $\mu A$ |
| $V_{OL}$ | Low Level Output Voltage           | $ I_O  < 1.0 \mu A$                         |       |      |       |            |      |        |      |         |
|          |                                    | $V_{DD} = 5V$                               |       | 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          | $ I_O  < 1.0 \mu A$                         |       |      |       |            |      |        |      |         |
|          |                                    | $V_{DD} = 5V$                               | 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            | $ I_O  < 1.0 \mu A$                         |       |      |       |            |      |        |      |         |
|          |                                    | $V_{DD} = 5V, V_O = 0.5V$ or $4.5V$         |       | 1.5  |       |            | 1.5  |        | 1.5  | V       |
|          |                                    | $V_{DD} = 10V, V_O = 1.0V$ or $9.0V$        |       | 3.0  |       |            | 3.0  |        | 3.0  | V       |
|          |                                    | $V_{DD} = 15V, V_O = 1.5V$ or $13.5V$       |       | 4.0  |       |            | 4.0  |        | 4.0  | V       |
| $V_{IH}$ | High Level Input Voltage           | $ I_O  < 1.0 \mu A$                         |       |      |       |            |      |        |      |         |
|          |                                    | $V_{DD} = 5V, V_O = 0.5V$ or $4.5V$         | 3.5   |      | 3.5   |            |      | 3.5    |      | V       |
|          |                                    | $V_{DD} = 10V, V_O = 1.0V$ or $9.0V$        | 7.0   |      | 7.0   |            |      | 7.0    |      | V       |
|          |                                    | $V_{DD} = 15V, V_O = 1.5V$ or $13.5V$       | 11.0  |      | 11.0  |            |      | 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) | $V_{DD} = 5V, V_O = 4.6V$                   | −0.25 |      | −0.2  | 0.36       |      | −0.14  |      | mA      |
|          |                                    | $V_{DD} = 10V, V_O = 9.5V$                  | −0.62 |      | −0.5  | 0.9        |      | −0.35  |      | mA      |
|          |                                    | $V_{DD} = 15V, V_O = 13.5V$                 | −1.8  |      | −1.5  | −3.5       |      | −1.1   |      | mA      |
| $I_{IN}$ | Input Current                      | $V_{DD} = 15V, V_{IN} = 0V$                 |       | −0.1 |       | $-10^{-5}$ | −0.1 |        | −1.0 | $\mu A$ |
|          |                                    | $V_{DD} = 15V, V_{IN} = 15V$                |       | 0.1  |       | $10^{-5}$  | 0.1  |        | 1.0  | $\mu A$ |

**DC Electrical Characteristics** CD4035BC (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   |       | 0.5 | 20   |       | 150  | $\mu A$ |
|          |                           | $V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$ |       | 40   |       | 1.0 | 40   |       | 300  | $\mu A$ |
|          |                           | $V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$ |       | 80   |       | 5.0 | 80   |       | 600  | $\mu A$ |
| $V_{OL}$ | Low Level Output Voltage  | $ I_O  < 1 \mu A$                           |       |      |       |     |      |       |      |         |
|          |                           | $V_{DD} = 5V$                               |       | 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 | $ I_O  < 1 \mu A$                           |       |      |       |     |      |       |      |         |
|          |                           | $V_{DD} = 5V$                               | 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       |

## DC Electrical Characteristics CD4035BC (Note 2) (Continued)

| Symbol          | Parameter                             | Conditions  | −40°C                |                   | 25°C                  |                                       |                   | 85°C                  |                   | Units          |
|-----------------|---------------------------------------|---|----------------------|-------------------|-----------------------|---------------------------------------|-------------------|-----------------------|-------------------|----------------|
|                 |                                       |   | Min                  | Max               | Min                   | Typ                                   | Max               | Min                   | Max               |                |
| V <sub>IL</sub> | Low Level Input Voltage               | I <sub>O</sub>   < 1 μA<br>V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.5V or 4.5V<br>V <sub>DD</sub> = 10V, V <sub>O</sub> = 1.0V or 9.0V<br>V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V or 13.5V |                      | 1.5<br>3.0<br>4.0 |                       |                                       | 1.5<br>3.0<br>4.0 |                       | 1.5<br>3.0<br>4.0 | V<br>V<br>V    |
| V <sub>IH</sub> | High Level Input Voltage              | I <sub>O</sub>   < 1 μA<br>V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.5V or 4.5V<br>V <sub>DD</sub> = 10V, V <sub>O</sub> = 1.0V or 9.0V<br>V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V or 13.5V | 3.5<br>7.0<br>11.0   |                   | 3.5<br>7.0<br>11.0    |                                       |                   | 3.5<br>7.0<br>11.0    |                   | V<br>V<br>V    |
| I <sub>OL</sub> | Low Level Output Current<br>(Note 3)  | V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.4V<br>V <sub>DD</sub> = 10V, V <sub>O</sub> = 0.5V<br>V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V   | 0.52<br>1.3<br>3.6   |                   | 0.44<br>1.1<br>3.0    | 0.88<br>2.25<br>8.8                   |                   | 0.36<br>0.9<br>2.4    |                   | mA<br>mA<br>mA |
| I <sub>OH</sub> | High Level Output Current<br>(Note 3) | V <sub>DD</sub> = 5V, V <sub>O</sub> = 4.6V<br>V <sub>DD</sub> = 10V, V <sub>O</sub> = 9.5V<br>V <sub>DD</sub> = 15V, V <sub>O</sub> = 13.5V  | −0.2<br>−0.5<br>−1.4 |                   | −0.16<br>−0.4<br>−1.2 | 0.36<br>0.9<br>−3.5                   |                   | −0.12<br>−0.3<br>−1.0 |                   | mA<br>mA<br>mA |
| I <sub>IN</sub> | Input Current                         | V <sub>DD</sub> = 15V, V <sub>IN</sub> = 0V<br>V <sub>DD</sub> = 15V, V <sub>IN</sub> = 15V   |                      | −0.3<br>0.3       |                       | −10 <sup>−5</sup><br>10 <sup>−5</sup> | −0.3<br>0.3       |                       | −1.0<br>1.0       | μA<br>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 table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual device operation.

**Note 2:** V<sub>SS</sub> = 0V unless otherwise specified.

**Note 3:** I<sub>OH</sub> and I<sub>OL</sub> are tested one output at a time.

## AC Electrical Characteristics\*

T<sub>A</sub> = 25°C, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 200k, t<sub>r</sub> and t<sub>f</sub> = 20 ns, unless otherwise specified.

| Symbol                              | Parameter                                 | Conditions   | Min               | Typ              | Max               | Units             |
|-------------------------------------|---|--|-------------------|------------------|-------------------|-------------------|
| <b>CLOCKED OPERATION</b>            |   |  |                   |                  |                   |                   |
| t <sub>PHL</sub> , t <sub>PLH</sub> | Propagation Delay Time                    | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V |                   | 250<br>100<br>75 | 500<br>200<br>150 | ns<br>ns<br>ns    |
| t <sub>THL</sub>                    | Transition Time High<br>Low to High       | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V |                   | 90<br>50<br>40   | 175<br>75<br>60   | ns<br>ns<br>ns    |
| t <sub>TLH</sub>                    | Transition Time<br>Low to High            | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V |                   | 135<br>70<br>60  | 270<br>140<br>120 | ns<br>ns<br>ns    |
| t <sub>WL</sub> , t <sub>WH</sub>   | Minimum Clock Pulse Width                 | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V | 335<br>165<br>100 | 135<br>50<br>40  |                   | ns<br>ns<br>ns    |
| t <sub>rCL</sub> , t <sub>fCL</sub> | Clock Rise and Fall Time                  | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V |                   |                  | 15<br>10<br>5     | μs<br>μs<br>μs    |
| t <sub>S</sub>                      | Minimum Set-up Time<br>J/ $\bar{K}$ Lines | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V |                   | 250<br>100<br>80 | 500<br>200<br>160 | ns<br>ns<br>ns    |
| t <sub>S</sub>                      | Parallel-In Lines                         | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V |                   | 250<br>100<br>80 | 500<br>200<br>160 | ns<br>ns<br>ns    |
| t <sub>S</sub>                      | P/S Control                               | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V |                   | 100<br>40<br>35  | 200<br>80<br>60   | ns<br>ns<br>ns    |
| f <sub>MAX</sub>                    | Maximum Clock Frequency                   | V <sub>DD</sub> = 5V<br>V <sub>DD</sub> = 10V<br>V <sub>DD</sub> = 15V | 1.5<br>3<br>5     | 2.5<br>6<br>9    |                   | MHz<br>MHz<br>MHz |

## AC Electrical Characteristics\*

$T_A = 25^\circ\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}$ ,  $t_r$  and  $t_f = 20\text{ ns}$ , unless otherwise specified. (Continued)

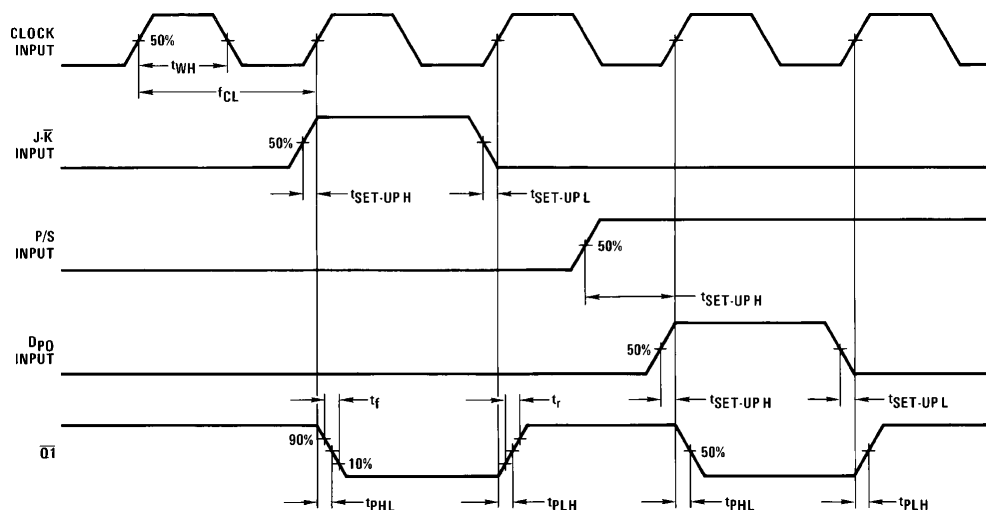
| Symbol                               | Parameter                 | Conditions            | Min | Typ | Max | Units |
|--------------------------------------|---------------------------|-----------------------|-----|-----|-----|-------|
| <b>CLOCKED OPERATION</b> (Continued) |                           |                       |     |     |     |       |
| $C_{IN}$                             | Input Capacitance         | Any Input             |     | 5   | 7.5 | pF    |
| <b>RESET OPERATION</b>               |                           |                       |     |     |     |       |
| $t_{PHL}, t_{PLH}$                   | Propagation Delay Time    | $V_{DD} = 5\text{V}$  |     | 300 | 500 | ns    |
|                                      |                           | $V_{DD} = 10\text{V}$ |     | 150 | 200 | ns    |
|                                      |                           | $V_{DD} = 15\text{V}$ |     | 85  | 150 | ns    |
| $t_{WH}$                             | Minimum Reset Pulse Width | $V_{DD} = 5\text{V}$  |     | 75  | 250 | ns    |
|                                      |                           | $V_{DD} = 10\text{V}$ |     | 30  | 110 | ns    |
|                                      |                           | $V_{DD} = 15\text{V}$ |     | 25  | 80  | ns    |

\*AC Parameters are guaranteed by DC correlated testing.

## Truth Table

| $C_L$ | $t_n - 1$ (Inputs) |           |   |           | $t_n$ (Outputs)                  |
|-------|--------------------|-----------|---|-----------|----------------------------------|
|       | J                  | $\bar{K}$ | R | $Q_{n-1}$ | $Q_n$                            |
|       | 0                  | X         | 0 | 0         | 0                                |
|       | 1                  | X         | 0 | 0         | 1                                |
|       | X                  | 0         | 0 | 1         | 0                                |
|       | 1                  | 0         | 0 | $Q_{n-1}$ | $\overline{Q_{n-1}}$ TOGGLE MODE |
|       | X                  | 1         | 0 | 1         | 1                                |
|       | X                  | X         | 0 | $Q_{n-1}$ | $Q_{n-1}$                        |
| X     | X                  | X         | 1 | X         | 0                                |

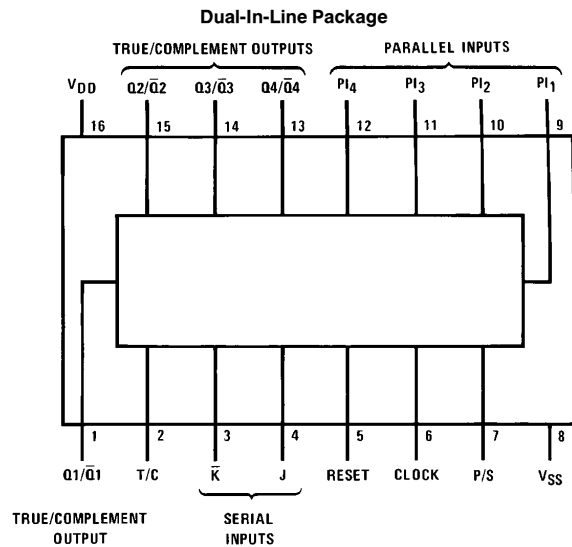
## Switching Time Waveforms



T/C Input Low  
Reset Input Low

TL/F/5964-3

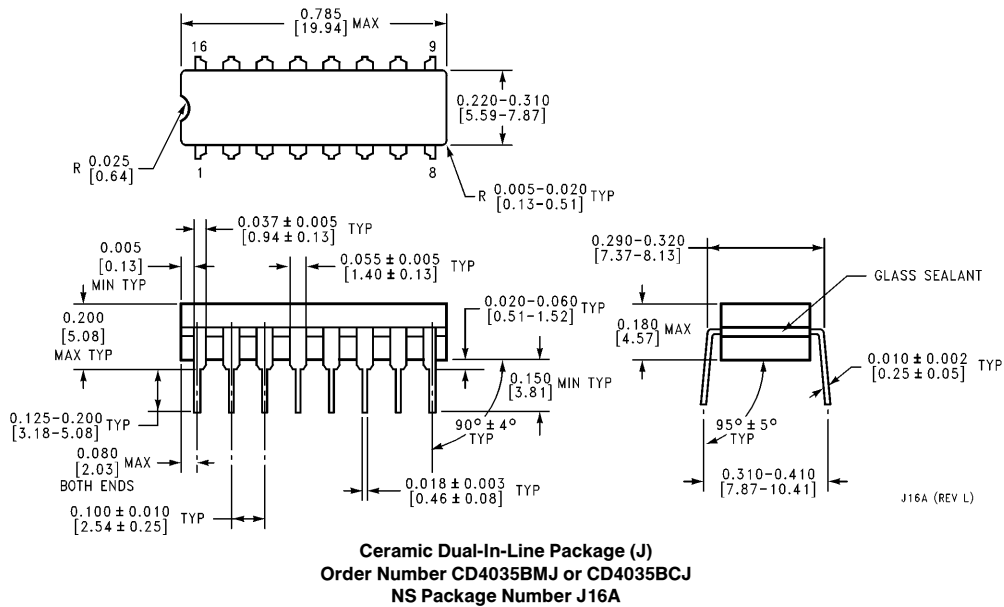
## Connection Diagram



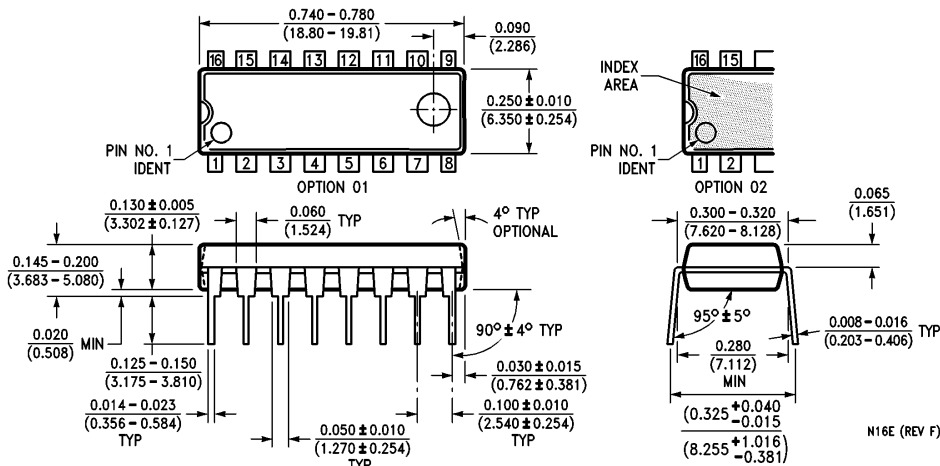
TL/F/5964-4

Order Number CD4035B

## Physical Dimensions inches (millimeters)



## Physical Dimensions inches (millimeters) (Continued)



**Molded Dual-In-Line Package (N)**  
**Order Number CD4035BMN or CD4035BCN**  
**NS Package Number N16E**

### LIFE SUPPORT POLICY

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2. A critical component is 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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