

CD4017BM/CD4017BC Decade Counter/Divider with 10 Decoded Outputs

CD4022BM/CD4022BC Divide-by-8 Counter/Divider with 8 Decoded Outputs

General Description

The CD4017BM/CD4017BC is a 5-stage divide-by-10 Johnson counter with 10 decoded outputs and a carry out bit.

The CD4022BM/CD4022BC is a 4-stage divide-by-8 Johnson counter with 8 decoded outputs and a carry-out bit.

These counters are cleared to their zero count by a logical "1" on their reset line. These counters are advanced on the positive edge of the clock signal when the clock enable signal is in the logical "0" state.

The configuration of the CD4017BM/CD4017BC and CD4022BM/CD4022BC permits medium speed operation and assures a hazard free counting sequence. The 10/8 decoded outputs are normally in the logical "0" state and go to the logical "1" state only at their respective time slot. Each decoded output remains high for 1 full clock cycle. The carry-out signal completes a full cycle for every 10/8 clock input cycles and is used as a ripple carry signal to any succeeding stages.

Features

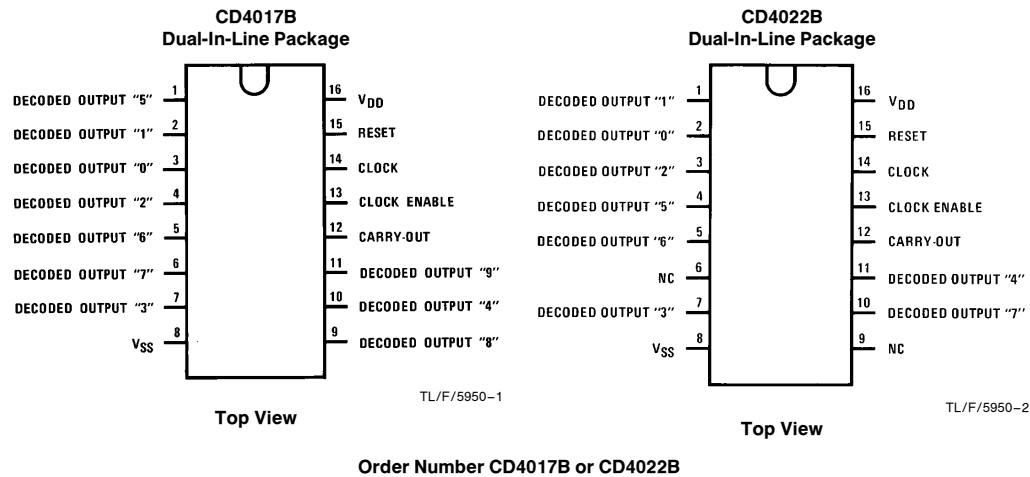
- Wide supply voltage range
- High noise immunity
- Low power
- Medium speed operation
- Low power
- Fully static operation

3.0V to 15V
 0.45 V_{DD} (typ.)
 Fan out of 2 driving 74L
 or 1 driving 74LS
 5.0 MHz (typ.)
 with 10V V_{DD}
 10 μW (typ.)

Applications

- Automotive
- Instrumentation
- Medical electronics
- Alarm systems
- Industrial electronics
- Remote metering

Connection Diagrams



CD4017BM/CD4017BC Decade Counter/Divider with 10 Decoded Outputs
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Absolute Maximum Ratings (Notes 1 & 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}) | -0.5 V_{DC} to +18 V_{DC} |
| Input Voltage (V_{IN}) | -0.5 V_{DC} to V_{DD} + 0.5 V_{DC} |
| Storage Temperature (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 (Note 2)

| | |
|---------------------------------------|-----------------------------|
| DC Supply Voltage (V_{DD}) | +3 V_{DC} to +15 V_{DC} |
| Input Voltage (V_{IN}) | 0 to V_{DD} V_{DC} |
| Operating Temperature Range (T_A) | |
| CD4017BM, CD4022BM | -55°C to +125°C |
| CD4017BC, CD4022BC | -40°C to +85°C |

DC Electrical Characteristics CD4017BM, CD4022BM (Note 2)

| Symbol | Parameter | Conditions | -55°C | | +25° | | | +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 | μA |
| | | $V_{DD} = 10V, V_{IN} = V_{DD}$ or V_{SS} | | 10 | | 0.5 | 10 | | 300 | μA |
| | | $V_{DD} = 15V, V_{IN} = V_{DD}$ or V_{SS} | | 20 | | 1.0 | 20 | | 600 | μA |
| 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_{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_{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_{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 |
| 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 | μA |
| | | $V_{DD} = 15V, V_{IN} = 15V$ | | 0.1 | | 10^{-5} | 0.1 | | 1.0 | μA |

DC Electrical Characteristics CD4017BC, CD4022BC (Note 2)

| Symbol | Parameter | Conditions | -40°C | | +25° | | | +85°C | | Units |
|----------|---------------------------|---------------------|-------|------|-------|-----|------|-------|------|---------|
| | | | Min | Max | Min | Typ | Max | Min | Max | |
| I_{DD} | Quiescent Device Current | $V_{DD} = 5V$ | | 20 | | 0.5 | 20 | | 150 | μA |
| | | $V_{DD} = 10V$ | | 40 | | 1.0 | 40 | | 300 | μA |
| | | $V_{DD} = 15V$ | | 80 | | 5.0 | 80 | | 600 | μA |
| 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_{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_{OH} | High Level Output Voltage | $V_{DD} = 15V$ | 14.95 | | 14.95 | 15 | | 14.95 | | V |

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: $V_{SS} = 0V$ unless otherwise specified.

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

DC Electrical Characteristics CD4017BC, CD4022BC (Note 2) (Continued)

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

Note 2: V_{SS} = 0V unless otherwise specified.

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

AC Electrical Characteristics*

T_A = 25°C, C_L = 50 pF, R_L = 200k, t_{rCL} and t_{fCL} = 20 ns, unless otherwise specified

| Symbol | Parameter | Conditions | Min | Typ | Max | Units | |
|-------------------------------------|---|--|--|-------------------|-------------|-------------------|----|
| CLOCK OPERATION | | | | | | | |
| t _{PHL} , t _{PLH} | Propagation Delay Time Carry Out Line | V _{DD} = 5V | | 415 | 800 | ns | |
| | | V _{DD} = 10V | | 160 | 320 | ns | |
| | | V _{DD} = 15V | | 130 | 250 | ns | |
| | Carry Out Line | } C _L = 15 pF | V _{DD} = 5V | | 240 | 480 | ns |
| | | | V _{DD} = 10V | | 85 | 170 | ns |
| | | | V _{DD} = 15V | | 70 | 140 | ns |
| Decode Out Lines | | | 500 | 1000 | ns | | |
| | | | 200 | 400 | ns | | |
| | | | 160 | 320 | ns | | |
| t _{TLH} , t _{THL} | Transition Time Carry Out and Decode Out Lines t _{TLH} | V _{DD} = 5V | | 200 | 360 | ns | |
| | | V _{DD} = 10V | | 100 | 180 | ns | |
| | | V _{DD} = 15V | | 80 | 130 | ns | |
| | t _{THL} | V _{DD} = 5V | | 100 | 200 | ns | |
| | | V _{DD} = 10V | | 50 | 100 | ns | |
| | | V _{DD} = 15V | | 40 | 80 | ns | |
| f _{CL} | Maximum Clock Frequency | V _{DD} = 5V V _{DD} = 10V V _{DD} = 15V | Measured with Respect to Carry Output Line | 1.0 2.5 3.0 | 2 5 6 | MHz MHz MHz | |
| t _{WL} , t _{WH} | Minimum Clock Pulse Width | V _{DD} = 5V | | 125 | 250 | ns | |
| | | V _{DD} = 10V | | 45 | 90 | ns | |
| | | V _{DD} = 15V | | 35 | 70 | ns | |
| t _{rCL} , t _{fCL} | Clock Rise and Fall Time | V _{DD} = 5V | | | 20 | μs | |
| | | V _{DD} = 10V | | | 15 | μs | |
| | | V _{DD} = 15V | | | 5 | μs | |
| t _{SU} | Minimum Clock Inhibit Data Setup Time | V _{DD} = 5V | | 120 | 240 | ns | |
| | | V _{DD} = 10V | | 40 | 80 | ns | |
| | | V _{DD} = 15V | | 32 | 65 | ns | |
| C _{IN} | Average Input Capacitance | | | 5 | 7.5 | pF | |

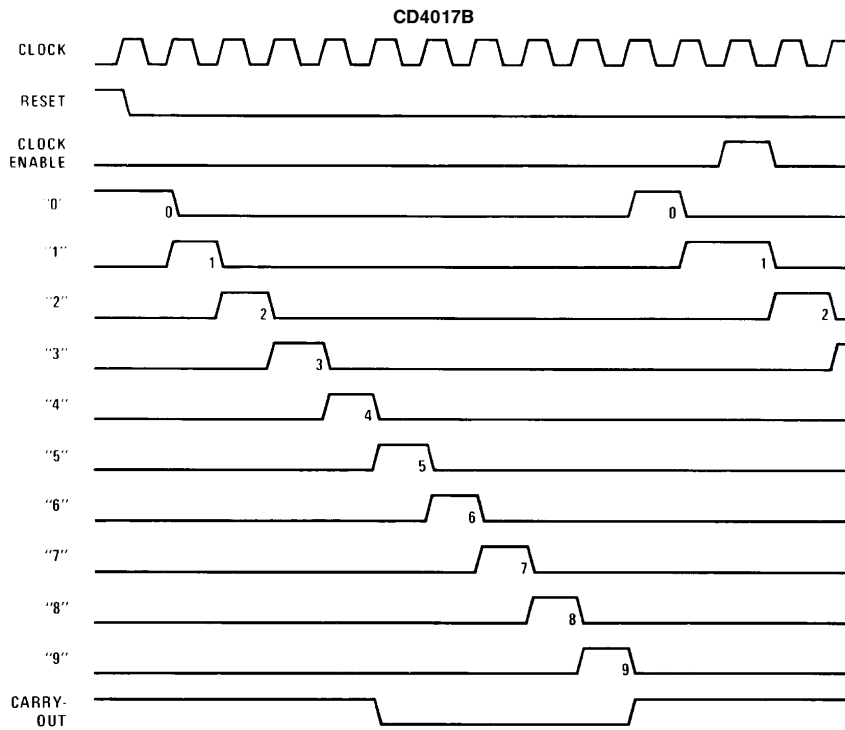
AC Electrical Characteristics*

$T_A = 25^\circ\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ k}$, t_{rCL} and $t_{fCL} = 20\text{ ns}$, unless otherwise specified

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|------------------------|--|-----------------------|------------------------|-----|------|-------|
| RESET OPERATION | | | | | | |
| t_{PHL} , t_{PLH} | Propagation Delay Time Carry Out Line | $V_{DD} = 5\text{V}$ | | 415 | 800 | ns |
| | | $V_{DD} = 10\text{V}$ | | 160 | 320 | ns |
| | | $V_{DD} = 15\text{V}$ | | 130 | 250 | ns |
| | Carry Out Line | $V_{DD} = 5\text{V}$ | } $C_L = 15\text{ pF}$ | 240 | 480 | ns |
| | | $V_{DD} = 10\text{V}$ | | 85 | 170 | ns |
| | | $V_{DD} = 15\text{V}$ | | 70 | 140 | ns |
| | Decode Out Lines | $V_{DD} = 5\text{V}$ | | 500 | 1000 | ns |
| | | $V_{DD} = 10\text{V}$ | | 200 | 400 | ns |
| | | $V_{DD} = 15\text{V}$ | | 160 | 320 | ns |
| t_w | Minimum Reset Pulse Width | $V_{DD} = 5\text{V}$ | | 200 | 400 | ns |
| | | $V_{DD} = 10\text{V}$ | | 70 | 140 | ns |
| | | $V_{DD} = 15\text{V}$ | | 55 | 110 | ns |
| t_{REM} | Minimum Reset Removal Time | $V_{DD} = 5\text{V}$ | | 75 | 150 | ns |
| | | $V_{DD} = 10\text{V}$ | | 30 | 60 | ns |
| | | $V_{DD} = 15\text{V}$ | | 25 | 50 | ns |

*AC Parameters are guaranteed by DC correlated testing.

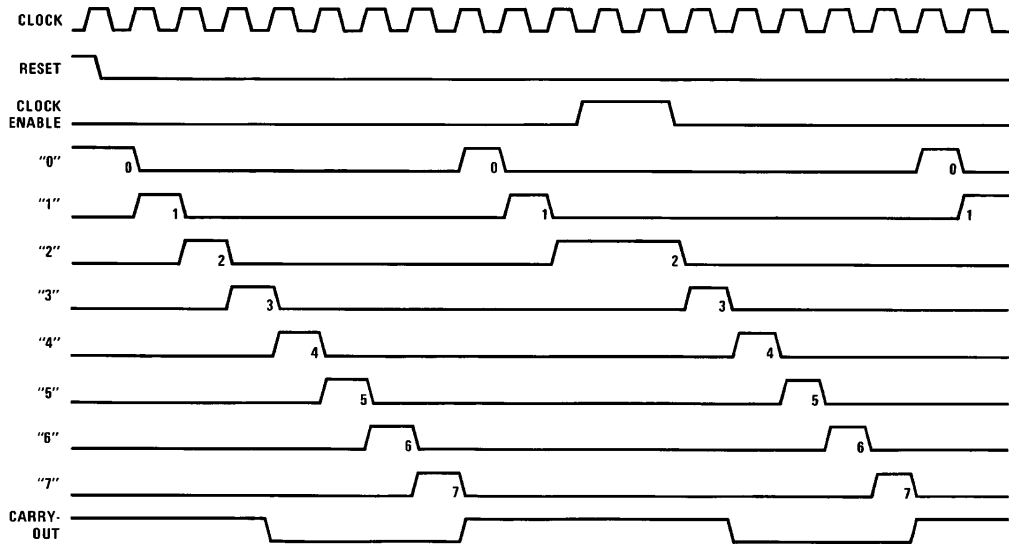
Timing Diagrams



TL/F/5950-3

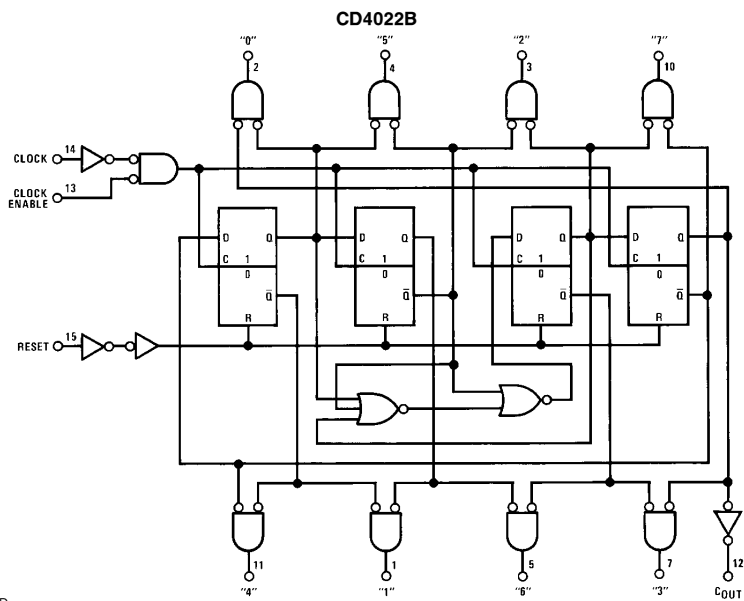
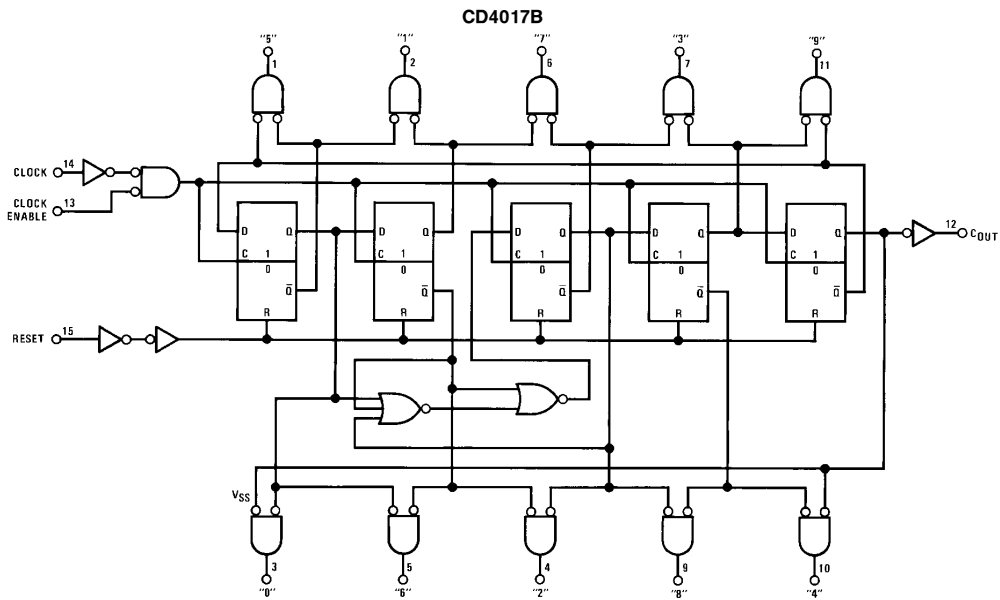
Timing Diagrams (Continued)

CD4022B

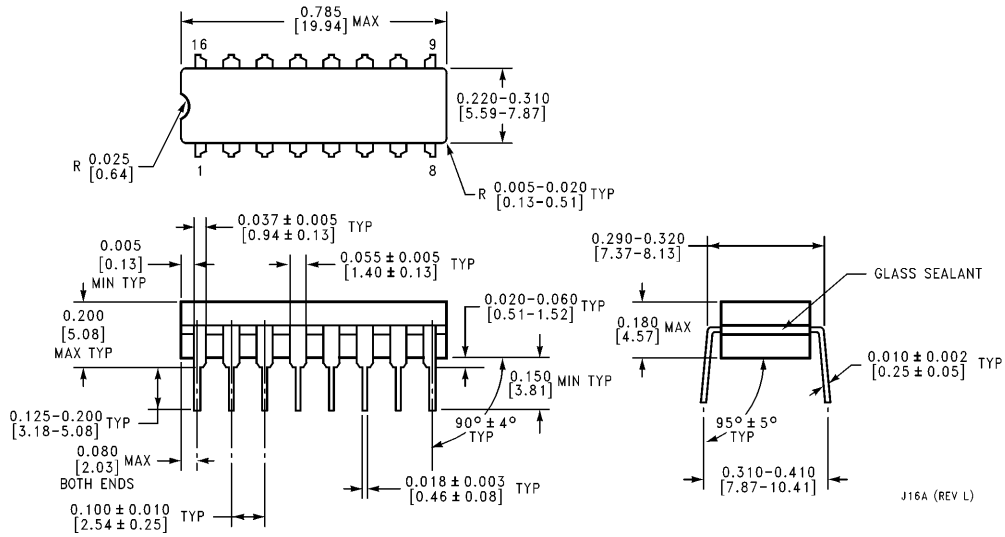


TL/F/5950-4

Logic Diagrams



Physical Dimensions inches (millimeters)

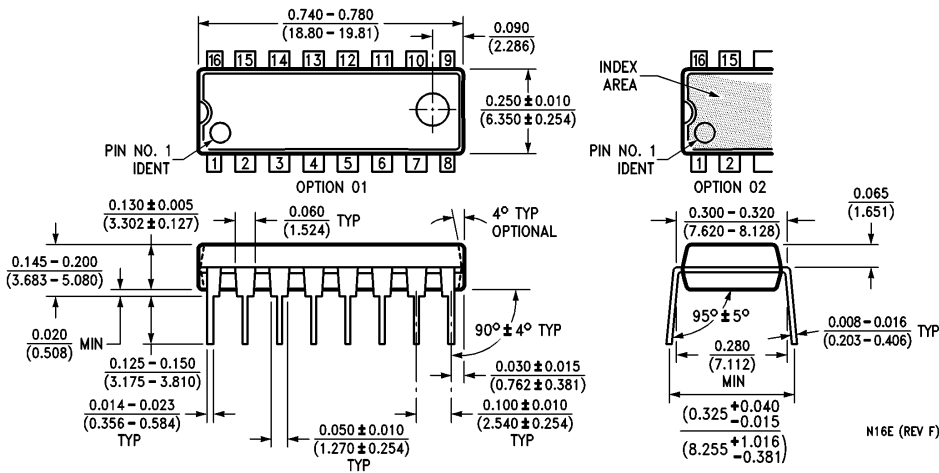


Ceramic Dual-In-Line Package (J)
Order Number CD4017BMJ, CD4017BCJ, CD4022BMJ, CD4022BCJ
NS Package Number J16A

J16A (REV L)

CD4017BM/CD4017BC Decade Counter/Divider with 10 Decoded Outputs
CD4022BM/CD4022BC Divide-by-8 Counter/Divider with 8 Decoded Outputs

Physical Dimensions inches (millimeters) (Continued)



Moulded Dual-In-Line Package (N)
Order Number CD4017BMN, CD4017BCN, CD4022BMN, CD4022BCN
NS Package Number N16E

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