

DM5490/DM7490A, DM7493A Decade and Binary Counters

General Description

Each of these monolithic counters contains four master-slave flip-flops and additional gating to provide a divide-by-two counter and a three-stage binary counter for which the count cycle length is divide-by-five for the 90A and divide-by-eight for the 93A.

All of these counters have a gated zero reset and the 90A also has gated set-to-nine inputs for use in BCD nine's complement applications.

To use their maximum count length (decade or four-bit binary), the B input is connected to the Q_A output. The input count pulses are applied to input A and the outputs are as

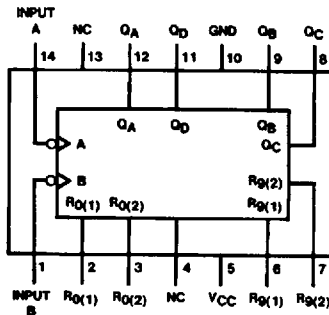
described in the appropriate truth table. A symmetrical divide-by-ten count can be obtained from the 90A counters by connecting the Q_D output to the A input and applying the input count to the B input which gives a divide-by-ten square wave at output Q_A .

Features

- Typical power dissipation
 - 90A 145 mW
 - 93A 130 mW
- Count frequency 42 MHz

Connection Diagrams

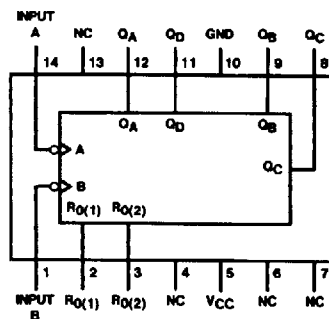
Dual-In-Line Package



TL/F/6533-1

Order Number DM5490J, DM5490W or DM7490AN
See NS Package Number J14A, N14A or W14B

Dual-In-Line Package



TL/F/6533-2

Order Number DM7493AN
See NS Package Number N14A

Absolute Maximum Ratings (Note)

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

| | |
|--------------------------------------|-----------------|
| Supply Voltage | 7V |
| Input Voltage | 5.5V |
| Operating Free Air Temperature Range | |
| DM54 | -55°C to +125°C |
| DM74 | 0°C to +70°C |
| Storage Temperature Range | -65°C to +150°C |

Note: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Recommended Operating Conditions

| Symbol | Parameter | | DM5490 | | | DM7490A | | | Units |
|------------------|--------------------------------|-------|--------|-----|------|---------|-----|------|-------|
| | | | Min | Nom | Max | Min | Nom | Max | |
| V _{CC} | Supply Voltage | | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} | High Level Input Voltage | | 2 | | | 2 | | | V |
| V _{IL} | Low Level Input Voltage | | | | 0.8 | | | 0.8 | V |
| I _{OH} | High Level Output Current | | | | -0.8 | | | -0.8 | mA |
| I _{OL} | Low Level Output Current | | | | 16 | | | 16 | mA |
| f _{CLK} | Clock Frequency (Note 5) | A | 0 | | 32 | 0 | | 32 | MHz |
| | | B | 0 | | 16 | 0 | | 16 | |
| t _w | Pulse Width (Note 5) | A | 15 | | | 15 | | | ns |
| | | B | 30 | | | 30 | | | |
| | | Reset | 15 | | | 15 | | | |
| t _{REL} | Reset Release Time (Note 5) | | 25 | | | 25 | | | ns |
| T _A | Free Air Operating Temperature | | -55 | | 125 | 0 | | 70 | °C |

'90A Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

| Symbol | Parameter | Conditions | Min | Typ (Note 1) | Max | Units |
|-----------------|-----------------------------------|---|-------|--------------|------|-------|
| V _I | Input Clamp Voltage | V _{CC} = Min, I _I = -12 mA | | | -1.5 | V |
| V _{OH} | High Level Output Voltage | V _{CC} = Min, I _{OH} = Max V _{IL} = Max, V _{IH} = Min | 2.4 | 3.4 | | V |
| V _{OL} | Low Level Output Voltage | V _{CC} = Min, I _{OL} = Max V _{IH} = Min, V _{IL} = Max (Note 4) | | 0.2 | 0.4 | V |
| I _I | Input Current @ Max Input Voltage | V _{CC} = Max, V _I = 5.5V | | | 1 | mA |
| I _{IH} | High Level Input Current | V _{CC} = Max V _I = 2.7V | A | | 80 | μA |
| | | | Reset | | 40 | |
| | | | B | | 120 | |
| I _{IL} | Low Level Input Current | V _{CC} = Max V _I = 0.4V | A | | -3.2 | mA |
| | | | Reset | | -1.6 | |
| | | | B | | -4.8 | |
| I _{OS} | Short Circuit Output Current | V _{CC} = Max (Note 2) | DM54 | -20 | -57 | mA |
| | | | DM74 | -18 | -57 | |
| I _{CC} | Supply Current | V _{CC} = Max (Note 3) | | 29 | 42 | mA |

Note 1: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 2: Not more than one output should be shorted at a time.

Note 3: I_{CC} is measured with all outputs open, both RO inputs grounded following momentary connection to 4.5V, and all other inputs grounded.

Note 4: Q_A outputs are tested at I_{OL} = Max plus the limit value of I_{IL} for the B input. This permits driving the B input while maintaining full fan-out capability.

Note 5: T_A = 25°C and V_{CC} = 5V.

'90A Switching Characteristics

at $V_{CC} = 5V$ and $T_A = 25^\circ C$ (See Section 1 for Test Waveforms and Output Load)

| Symbol | Parameter | From (Input) To (Output) | $R_L = 400\Omega$ $C_L = 15 pF$ | | Units |
|-----------|--|-----------------------------|------------------------------------|-----|-------|
| | | | Min | Max | |
| f_{MAX} | Maximum Clock Frequency | A to Q_A | 32 | | MHz |
| | | B to Q_B | 16 | | |
| t_{PLH} | Propagation Delay Time Low to High Level Output | A to Q_A | | 16 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | A to Q_A | | 18 | ns |
| t_{PLH} | Propagation Delay Time Low to High Level Output | A to Q_D | | 48 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | A to Q_D | | 50 | ns |
| t_{PLH} | Propagation Delay Time Low to High Level Output | B to Q_B | | 16 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | B to Q_B | | 21 | ns |
| t_{PLH} | Propagation Delay Time Low to High Level Output | B to Q_C | | 32 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | B to Q_C | | 35 | ns |
| t_{PLH} | Propagation Delay Time Low to High Level Output | B to Q_D | | 32 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | B to Q_D | | 35 | ns |
| t_{PLH} | Propagation Delay Time Low to High Level Output | SET-9 to Q_A, Q_D | | 30 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | SET-9 to Q_B, Q_C | | 40 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | SET-0 Any Q | | 40 | ns |

Recommended Operating Conditions

| Symbol | Parameter | DM7493A | | | Units |
|-----------|--------------------------------|---------|-----|------|-------|
| | | Min | Nom | Max | |
| V_{CC} | Supply Voltage | 4.75 | 5 | 5.25 | V |
| V_{IH} | High Level Input Voltage | 2 | | | V |
| V_{IL} | Low Level Input Voltage | | | 0.8 | V |
| I_{OH} | High Level Output Current | | | -0.8 | mA |
| I_{OL} | Low Level Output Current | | | 16 | mA |
| f_{CLK} | Clock Frequency (Note 5) | A | 0 | 32 | MHz |
| | | B | 0 | 16 | |
| t_w | Pulse Width (Note 5) | A | 15 | | ns |
| | | B | 30 | | |
| | | Reset | 15 | | |
| t_{REL} | Reset Release Time (Note 5) | 25 | | | ns |
| T_A | Free Air Operating Temperature | 0 | | 70 | °C |

'93A Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

| Symbol | Parameter | Conditions | Min | Typ (Note 1) | Max | Units |
|----------|-----------------------------------|---|-------|-----------------|------|---------------|
| V_I | Input Clamp Voltage | $V_{CC} = \text{Min}, I_I = -12 \text{ mA}$ | | | -1.5 | V |
| V_{OH} | High Level Output Voltage | $V_{CC} = \text{Min}, I_{OH} = \text{Max}$ $V_{IL} = \text{Max}, V_{IH} = \text{Min}$ | 2.4 | 3.4 | | V |
| V_{OL} | Low Level Output Voltage | $V_{CC} = \text{Min}, I_{OL} = \text{Max}$ $V_{IH} = \text{Min}, V_{IL} = \text{Max}$ (Note 4) | | 0.2 | 0.4 | V |
| I_I | Input Current @ Max Input Voltage | $V_{CC} = \text{Max}, V_I = 5.5V$ | | | 1 | mA |
| I_{IH} | High Level Input Current | $V_{CC} = \text{Max}$ $V_I = 2.4V$ | Reset | | 40 | μA |
| | | | A | | 80 | |
| | | | B | | 80 | |
| I_{IL} | Low Level Input Current | $V_{CC} = \text{Max}$ $V_I = 0.4V$ | Reset | | -1.6 | mA |
| | | | A | | -3.2 | |
| | | | B | | -3.2 | |
| I_{OS} | Short Circuit Output Current | $V_{CC} = \text{Max}$ (Note 2) | -18 | | -57 | mA |
| I_{CC} | Supply Current | $V_{CC} = \text{Max}$ (Note 3) | | 26 | 39 | mA |

Note 1: All typicals are at $V_{CC} = 5V, T_A = 25^\circ\text{C}$.

Note 2: Not more than one output should be shorted at a time.

Note 3: I_{CC} is measured with all outputs open, both R0 inputs grounded following momentary connection to 4.5V and all other inputs grounded.

Note 4: Q_A outputs are tested at $I_{OL} = \text{Max}$ plus the limit value of I_{IL} for the B input. This permits driving the B input while maintaining full fan-out capability.

Note 5: $T_A = 25^\circ\text{C}$ and $V_{CC} = 5V$.

'93A Switching Characteristics

at $V_{CC} = 5V$ and $T_A = 25^\circ C$ (See Section 1 for Test Waveforms and Output Load)

| Symbol | Parameter | From (Input) To (Output) | $R_L = 400\Omega$ $C_L = 15\text{ pF}$ | | Units |
|-----------|--|-----------------------------|---|-----|-------|
| | | | Min | Max | |
| f_{MAX} | Maximum Clock Frequency | A to Q_A | 32 | | MHz |
| | | B to Q_B | 16 | | |
| t_{PLH} | Propagation Delay Time Low to High Level Output | A to Q_A | | 16 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | A to Q_A | | 18 | ns |
| t_{PLH} | Propagation Delay Time Low to High Level Output | A to Q_D | | 70 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | A to Q_D | | 70 | ns |
| t_{PLH} | Propagation Delay Time Low to High Level Output | B to Q_B | | 16 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | B to Q_B | | 21 | ns |
| t_{PLH} | Propagation Delay Time Low to High Level Output | B to Q_C | | 32 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | B to Q_C | | 35 | ns |
| t_{PLH} | Propagation Delay Time Low to High Level Output | B to Q_D | | 51 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | B to Q_D | | 51 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | SET-0 to Any Q | | 40 | ns |

Function Tables (Note D)

90A
BCD Count Sequence
(See Note A)

| Count | Outputs | | | |
|-------|----------------|----------------|----------------|----------------|
| | Q _D | Q _C | Q _B | Q _A |
| 0 | L | L | L | L |
| 1 | L | L | L | H |
| 2 | L | L | H | L |
| 3 | L | L | H | H |
| 4 | L | H | L | L |
| 5 | L | H | L | H |
| 6 | L | H | H | L |
| 7 | L | H | H | H |
| 8 | H | L | L | L |
| 9 | H | L | L | H |

90A
BCD Bi-Quinary (5-2)
(See Note B)

| Count | Outputs | | | |
|-------|----------------|----------------|----------------|----------------|
| | Q _A | Q _D | Q _C | Q _B |
| 0 | L | L | L | L |
| 1 | L | L | L | H |
| 2 | L | L | H | L |
| 3 | L | L | H | H |
| 4 | L | H | L | L |
| 5 | H | L | L | L |
| 6 | H | L | L | H |
| 7 | H | L | H | L |
| 8 | H | L | H | H |
| 9 | H | H | L | L |

93A
Count Sequence
(See Note C)

| Count | Outputs | | | |
|-------|----------------|----------------|----------------|----------------|
| | Q _D | Q _C | Q _B | Q _A |
| 0 | L | L | L | L |
| 1 | L | L | L | H |
| 2 | L | L | H | L |
| 3 | L | L | H | H |
| 4 | L | H | L | L |
| 5 | L | H | L | H |
| 6 | L | H | H | L |
| 7 | L | H | H | H |
| 8 | H | L | L | L |
| 9 | H | L | L | H |
| 10 | H | L | H | L |
| 11 | H | L | H | H |
| 12 | H | H | L | L |
| 13 | H | H | L | H |
| 14 | H | H | H | L |
| 15 | H | H | H | H |

90A
Reset/Count Function Table

| Reset Inputs | | | | Outputs | | | |
|--------------|-------|-------|-------|----------------|----------------|----------------|----------------|
| R0(1) | R0(2) | R9(1) | R9(2) | Q _D | Q _C | Q _B | Q _A |
| H | H | L | X | L | L | L | L |
| H | H | X | L | L | L | L | L |
| X | X | H | H | H | L | L | H |
| X | L | X | L | | | | COUNT |
| L | X | L | X | | | | COUNT |
| L | X | X | L | | | | COUNT |
| X | L | L | X | | | | COUNT |

93A
Reset/Count Function Table

| Reset Inputs | | Outputs | | | |
|--------------|-------|----------------|----------------|----------------|----------------|
| R0(1) | R0(2) | Q _D | Q _C | Q _B | Q _A |
| H | H | L | L | L | L |
| L | X | | | | COUNT |
| X | L | | | | COUNT |

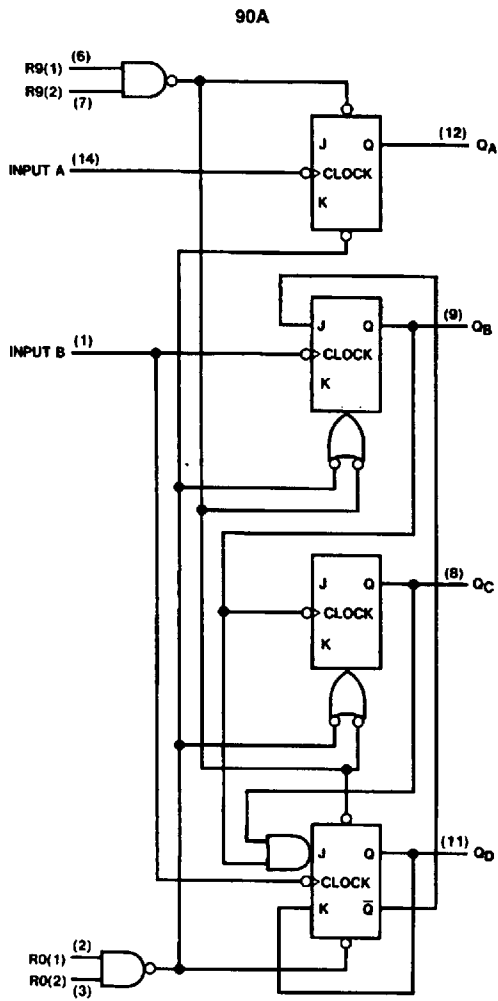
Note A: Output Q_A is connected to input B for BCD count.

Note B: Output Q_D is connected to input A for bi-quinary count.

Note C: Output Q_A is connected to input B.

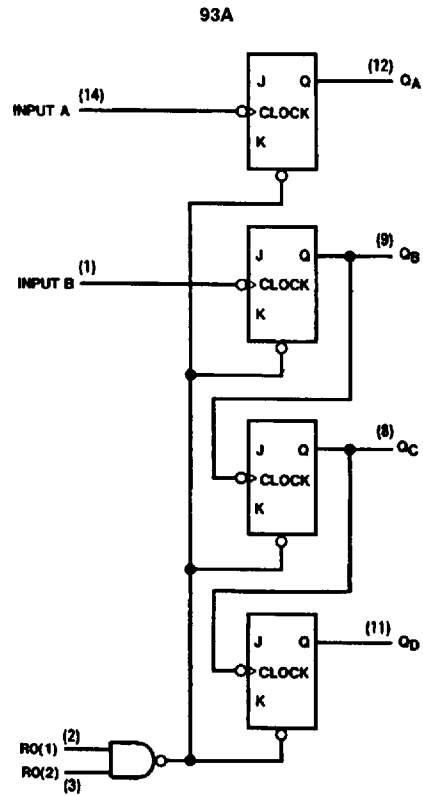
Note D: H = High Level, L = Low Level, X = Don't Care.

Logic Diagrams



TL/F/8533-3

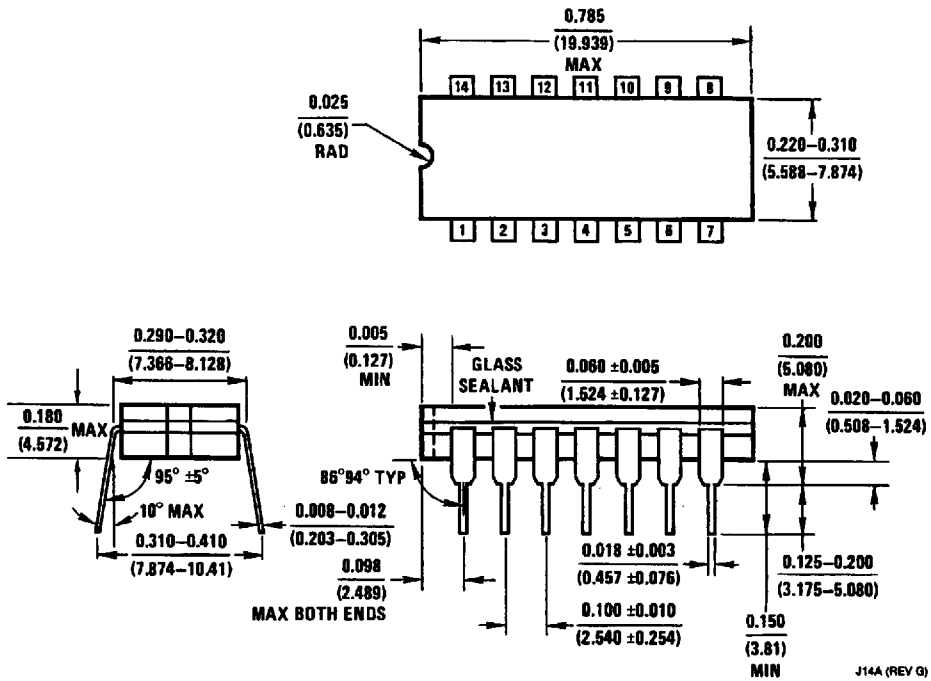
The J and K inputs shown without connection are for reference only and are functionally at a high level.



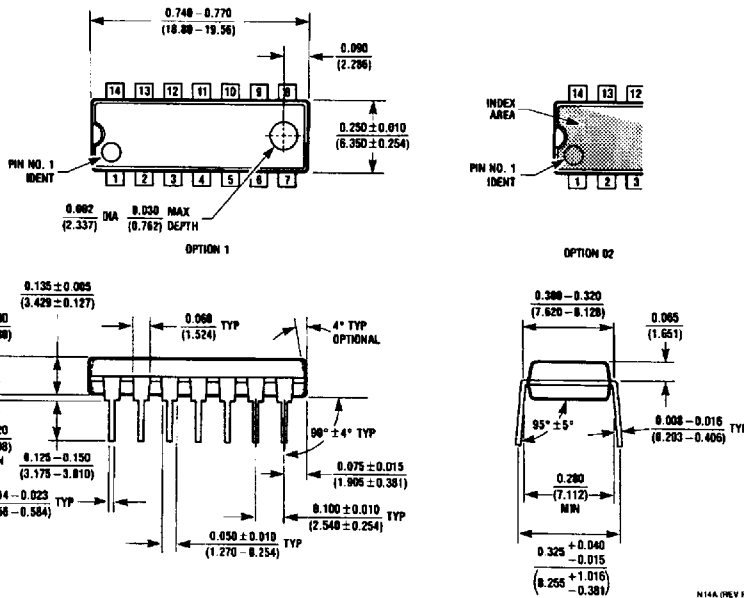
TL/F/8533-4

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Physical Dimensions inches (millimeters)



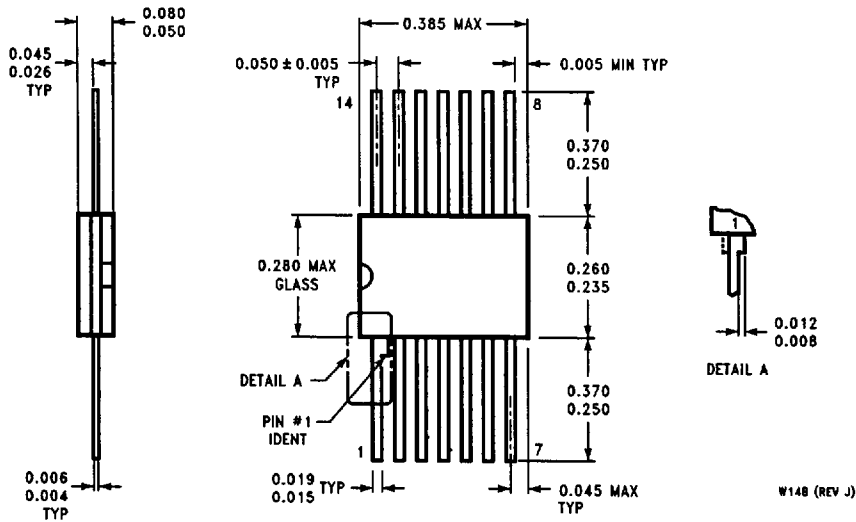
14-Lead Ceramic Dual-In-Line Package (J)
Order Number DM5490J
NS Package Number J14A



14-Lead Molded Dual-In-Line Package (N)
Order Number DM7490AN or DM7493AN
NS Package Number N14A

**DM5490/DM7490A, DM7493A
Decade and Binary Counters**

Physical Dimensions inches (millimeters) (Continued)



**14-Lead Ceramic Flat Package (W)
Order Number DM5490W
NS Package Number W14B**

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