FAIRCHILD SEMICONDUCTOR™

March 1998

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.

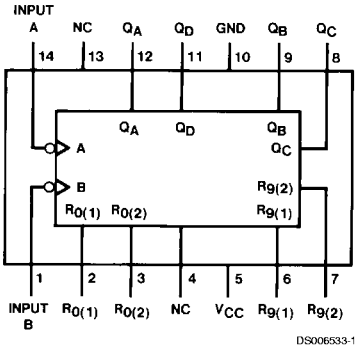
To use their maximum count length (decade or four-bit binary), the B input is connected to the Q_A output. The input count pulses are applied to input A and the outputs are as described in the appropriate truth table. A symmetrical divide-by-ten count can be obtained from the 90A counters by connecting 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

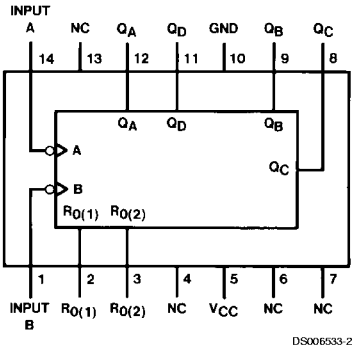
Connection Diagrams

Dual-In-Line Package



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

Dual-In-Line Package



Order Number DM7493AN
See Package Number N14A

Absolute Maximum Ratings (Note 1)

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

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	A	0		32	0		32	MHz
	(Note 6)	B	0		16	0		16	
t_W	Pulse Width	A	15			15			ns
	(Note 6)	B	30			30			
		Reset	15			15			
t_{REL}	Reset Release Time (Note 6)		25			25			ns
T_A	Free Air Operating Temperature		−55		125	0		70	°C

Note 1: *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.*

'90A Electrical Characteristics

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

Symbol	Parameter	Conditions		Min	Typ (Note 2)	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 5)			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 3)	DM54	−20		−57	mA
			DM74	−18		−57	
I_{CC}	Supply Current	V_{CC} = Max (Note 4)			29	42	mA

Note 2: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 3: Not more than one output should be shorted at a time.

Note 4: I_{CC} is measured with all outputs open, both RO inputs grounded following momentary connection to 4.5V, and all other inputs grounded.

Note 5: 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 6: T_A = 25°C and V_{CC} = 5V.

'90A Switching Characteristics

at V_{CC} = 5V and T_A = 25°C

Symbol	Parameter	From (Input) To (Output)	R_L = 400Ω 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 11)	A	0		32	MHz
		B	0		16	
t_W	Pulse Width (Note 11)	A	15			ns
		B	30			
		Reset	15			
t_{REL}	Reset Release Time (Note 11)		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 7)	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 10)			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 = 2.4V	Reset			40	µA
			A			80	
			B			80	
I_{IL}	Low Level Input Current	V_{CC} = Max V_I = 0.4V	Reset			−1.6	mA
			A			−3.2	
			B			−3.2	
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 8)		−18		−57	mA
I_{CC}	Supply Current	V_{CC} = Max (Note 9)			26	39	mA

Note 7: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 8: Not more than one output should be shorted at a time.

Note 9: I_{CC} is measured with all outputs open, both R0 inputs grounded following momentary connection to 4.5V and all other inputs grounded.

Note 10: 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 11: T_A = 25°C and V_{CC} = 5V.

'93A Switching Characteristics

at V_{CC} = 5V and T_A = 25°C

Symbol	Parameter	From (Input) To (Output)	R_L = 400Ω, 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		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

'93A Switching Characteristics (Continued)

at V_{CC} = 5V and T_A = 25°C

Symbol	Parameter	From (Input) To (Output)	R_L = 400Ω, C_L = 15 pF		Units
			Min	Max	
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 15)

90A BCD Count Sequence

(Note 12)

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)

(Note 13)

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

(Note 14)

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

Function Tables (Note 15) (Continued)

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

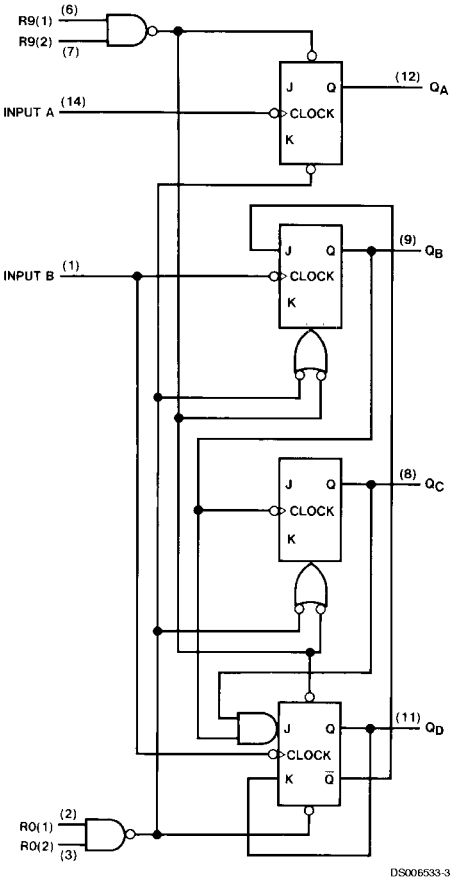
Note 13: Output Q_D is connected to input A for bi-quinary count.

Note 14: Output Q_A is connected to input B.

Note 15: H = High Level, L = Low Level, X = Don't Care.

Logic Diagrams

90A



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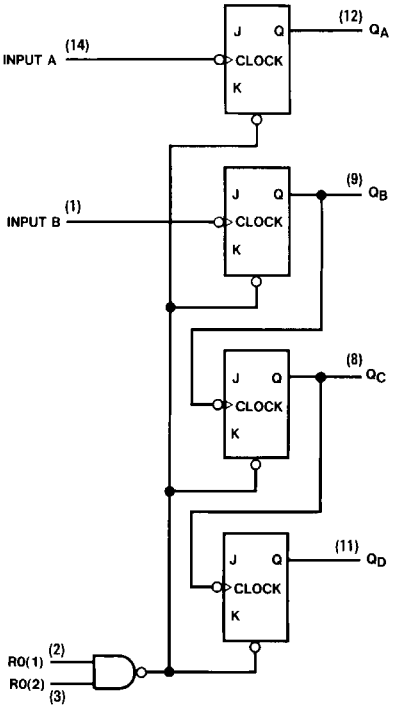
The J and K inputs shown without connection are for reference only and are functionally at a high level.

Logic Diagrams (Continued)

93A



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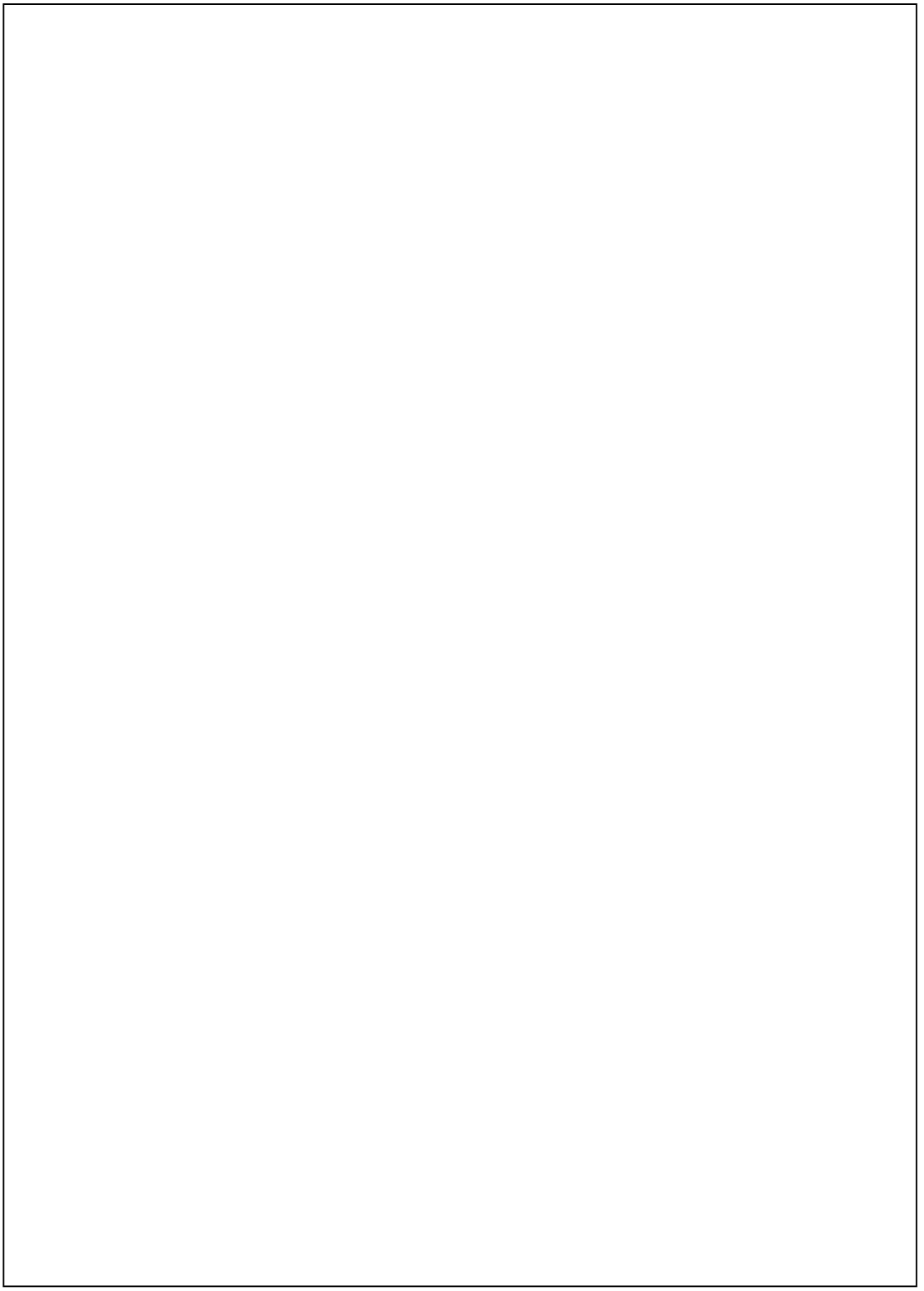
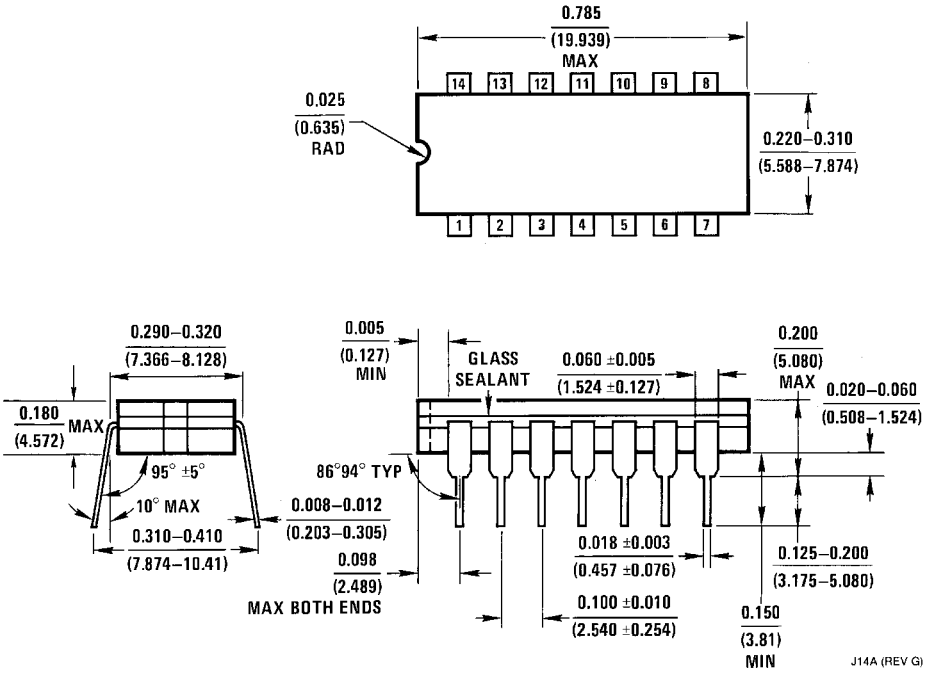
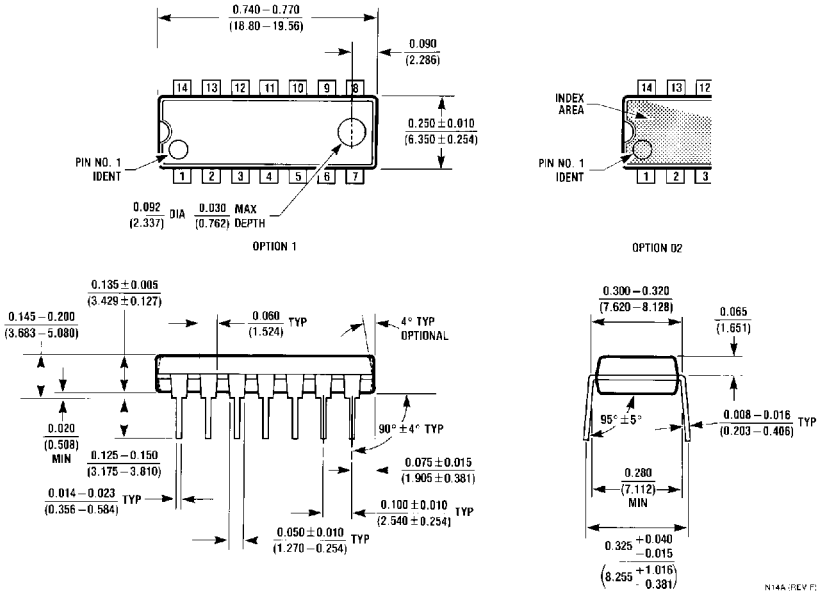


Physical Dimensions inches (millimeters) unless otherwise noted

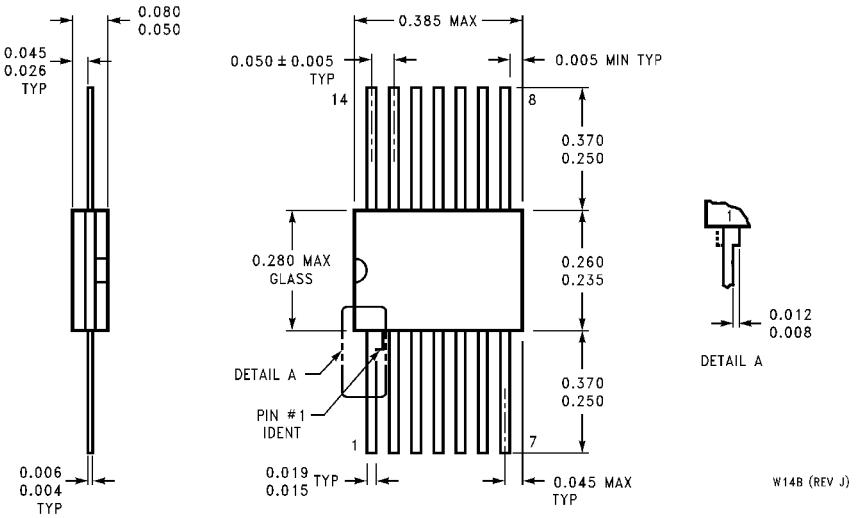


14-Lead Ceramic Dual-In-Line Package (J)
Order Number DM5490J
Package Number J14A



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

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



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

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