

## DM54ALS192/DM74ALS192/DM54ALS193/DM74ALS193 Synchronous Four-Bit Up/Down Counters (Dual Clock with Clear)

### General Description

The 'ALS192 and 'ALS193 are synchronous, reversible up/down counters. The 'ALS192 is a 4-bit decade counter and the 'ALS193 is a 4-bit binary counter. Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident with each other when so instructed by the steering logic. This mode of operation eliminates the output counting spikes normally associated with asynchronous (ripple clock) counters.

The outputs of the four flip-flops are triggered by a low-to-high level transition of either count (clock) input (up or down). The direction of counting is determined by which count input is pulsed while the other count input is high.

All four counters are fully programmable; that is, each output may be preset to either level by placing a low on the load input and entering the desired data at the data inputs. The output will change to agree with the data inputs independently of the count pulses. This feature allows the counters to be used as modulo-N dividers by simply modifying the count length with the preset inputs.

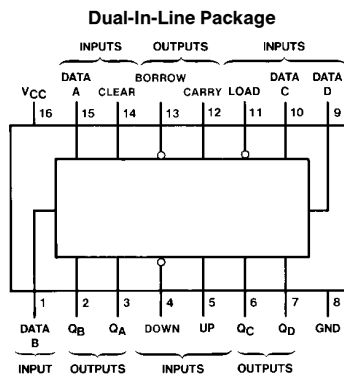
A clear input has been provided that forces all outputs to the low level when a high level is applied. The clear function is independent of the count and the load inputs. The clock, count, and load inputs are buffered to lower the drive requirements. This significantly reduces the loading on clock drivers, etc., for long parallel words.

These counters were designed to be cascaded without the need for external circuitry. The borrow output (BO) produces a low-level pulse while the count is zero (all outputs low) and the count-down input is low. Similarly, the carry output (CO) produces a low-level pulse while the count is maximum (9 or 15) and the count-up input is low. The counters can then be easily cascaded by feeding the borrow and carry outputs to the count-down and count-up inputs, respectively, of the succeeding counter.

### Features

- Switching specifications at 50 pF
- Switching specifications guaranteed over full temperature and  $V_{CC}$  range
- Advanced oxide-isolated, ion-implanted Schottky TTL process
- Functionally and pin-for-pin compatible with Schottky and low power Schottky TTL counterparts
- Improved AC performance over Schottky and low power Schottky counterparts
- Look ahead circuitry enhances cascaded counters
- Fully synchronous in count mode
- Parallel asynchronous load for modulo-N count lengths
- Asynchronous clear

### Connection Diagram



Order Number DM54ALS192J, 193J, DM74ALS192M, 193M or DM74ALS192N, 193N  
See NS Package Number J16A, M16A or N16A

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## Absolute Maximum Ratings

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

Supply Voltage	7V
Input Voltage	7V
Operating Free Air Temperature Range	
DM54ALS	-55°C to +125°C
DM74ALS	0 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		DM54ALS192, 193			DM74ALS192, 193			Units	
			Min	Typ	Max	Min	Typ	Max		
V <sub>CC</sub>	Supply Voltage		4.5	5	5.5	4.5	5	5.5	V	
V <sub>IH</sub>	High Level Input Voltage		2			2			V	
V <sub>IL</sub>	Low Level Input Voltage				0.7			0.8	V	
I <sub>OH</sub>	High Level Output Current				-0.4			-0.4	mA	
I <sub>OL</sub>	Low Level Output Current				4			8	mA	
f <sub>CLK</sub>	Clock Frequency	'ALS192	0		20	0		25	MHz	
		'ALS193	0		25	0		30	MHz	
t <sub>w</sub>	Pulse Duration	CLR High	10			10			ns	
		LOAD Low	25			20			ns	
		UP or DOWN High or Low	'ALS192	25			20			ns
			'ALS193	30			16.5			ns
t <sub>SU</sub>	Setup Time	Data before LOAD ↑	25			20			ns	
		CLR Inactive before UP ↑ or DOWN ↑	20			20			ns	
		LOAD Inactive before UP ↑ or DOWN ↑	20			20			ns	
		UP High before DOWN ↑	17			17			ns	
		DOWN High before UP ↑	15			15			ns	
t <sub>H</sub>	Hold Time	Data after LOAD ↑	5			5			ns	
		UP High after DOWN ↑	0			0			ns	
		DOWN High after UP ↑	0			0			ns	
T <sub>A</sub>	Operating Free Air Temperature		-55		125	0		70	°C	

## Electrical Characteristics over recommended operating free air temperature range

Symbol	Parameter	Conditions	DM74ALS192, 193			Units	
			Min	Typ (Note 1)	Max		
V <sub>IK</sub>	Input Clamp Voltage	V <sub>CC</sub> = 4.5V, I <sub>I</sub> = -18 mA			-1.5	V	
V <sub>OH</sub>	High Level Output	V <sub>CC</sub> = 4.5V to 5.5V I <sub>OH</sub> = -0.4 mA	V <sub>CC</sub> - 2			V	
V <sub>OL</sub>	Low Level Output Voltage	V <sub>CC</sub> = 4.5V	54/74ALS I <sub>OL</sub> = 4 mA		0.25	0.4	V
		V <sub>CC</sub> = 4.5V	74ALS I <sub>OL</sub> = 8 mA		0.35	0.5	V
I <sub>I</sub>	Input Current at Max Input Voltage	V <sub>CC</sub> = 5.5V, V <sub>I</sub> = 7V			0.1	mA	
I <sub>IH</sub>	High Level Input Current	V <sub>CC</sub> = 5.5V, V <sub>I</sub> = 2.7V			20	μA	
I <sub>IL</sub>	Low Level Input Current	V <sub>CC</sub> = 5.5V, V <sub>I</sub> = 0.4V	UP, DOWN		-0.2	mA	
			All Others		-0.1	mA	

## Electrical Characteristics over recommended operating free air temperature range (Continued)

Symbol	Parameter	Conditions	DM74ALS192, 193			Units
			Min	Typ (Note 1)	Max	
$I_O$	Output Drive Current	$V_{CC} = 5.5V, V_O = 2.25V$ (Note 2)	-30		-112	mA
$I_{CC}$	Supply Current	$V_{CC} = 5.5V$ (Note 3)		12	22	mA

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

**Note 2:** The output conditions have been chosen to produce a current that closely approximates one half of the true short circuit output current,  $I_{OS}$ .

**Note 3:**  $I_{CC}$  is measured with the clear and load inputs grounded, and all other inputs at 4.5V.

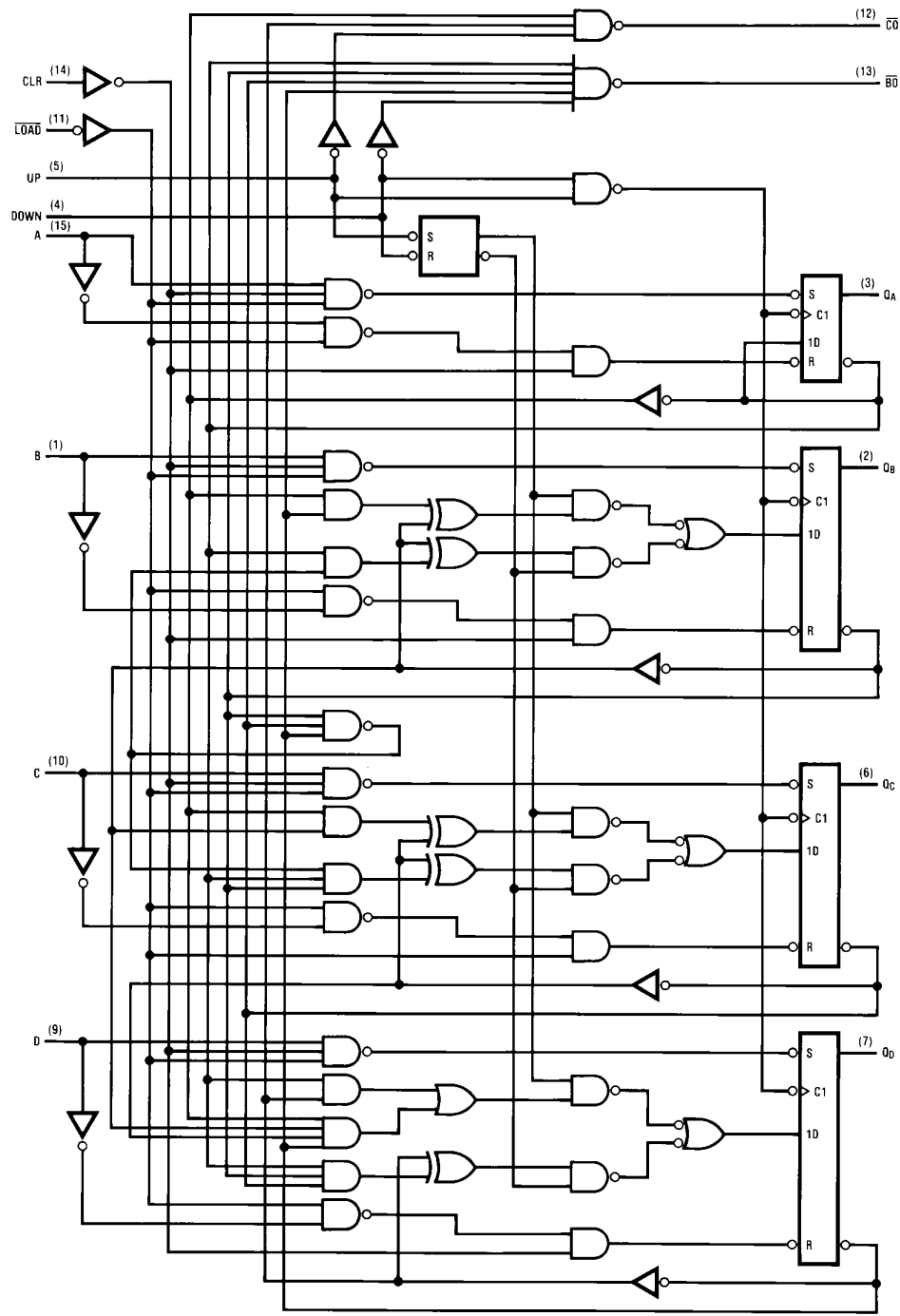
## Switching Characteristics (Note 4)

Symbol	Parameter	Conditions	From (Input)	To (Output)	DM54ALS192, 193		DM74ALS192, 193		Units
					Min	Max	Min	Max	
$f_{MAX}$	'ALS192	$V_{CC} = 4.5V$ to $5.5V$ $C_L = 50 pF$ $R_L = 500\Omega$ $T_A = \text{Min to Max}$			20		25		MHz
	'ALS193				25		30		MHz
$t_{PLH}$	Propagation Delay Time Low to High Level Output		Up	C0	3	20	4	16	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output		Up	C0	3	21	5	18	ns
$t_{PLH}$	Propagation Delay Time Low to High Level Output		Down	B0	4	20	4	16	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output		Down	B0	5	22	5	18	ns
$t_{PLH}$	Propagation Delay Time Low to High Level Output		Up or Down	Any Q	4	27	4	19	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output		Up or Down	Any Q	4	23	4	17	ns
$t_{PLH}$	Propagation Delay Time Low to High Level Output		$\overline{LOAD}$	Any Q	8	38	8	30	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output		$\overline{LOAD}$	Any Q	8	37	8	28	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output	CLR	Any Q	5	20	5	17	ns	

**Note 4:** See Section 5 for test waveforms and output load.

# Logic Diagrams

'ALS192

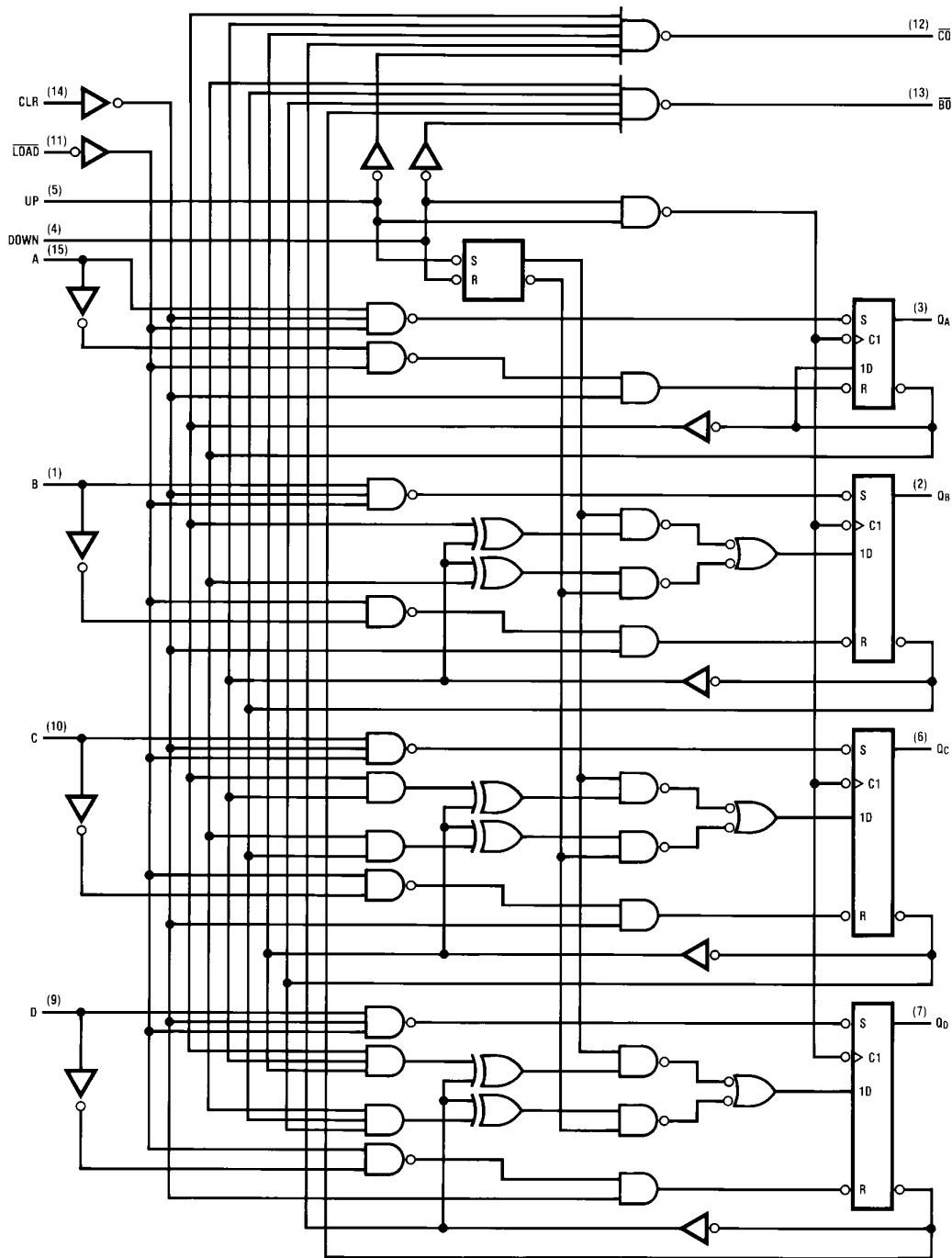


Pin numbers shown are for J and N packages.

TL/F/6209-2

Logic Diagrams (Continued)

'ALS193

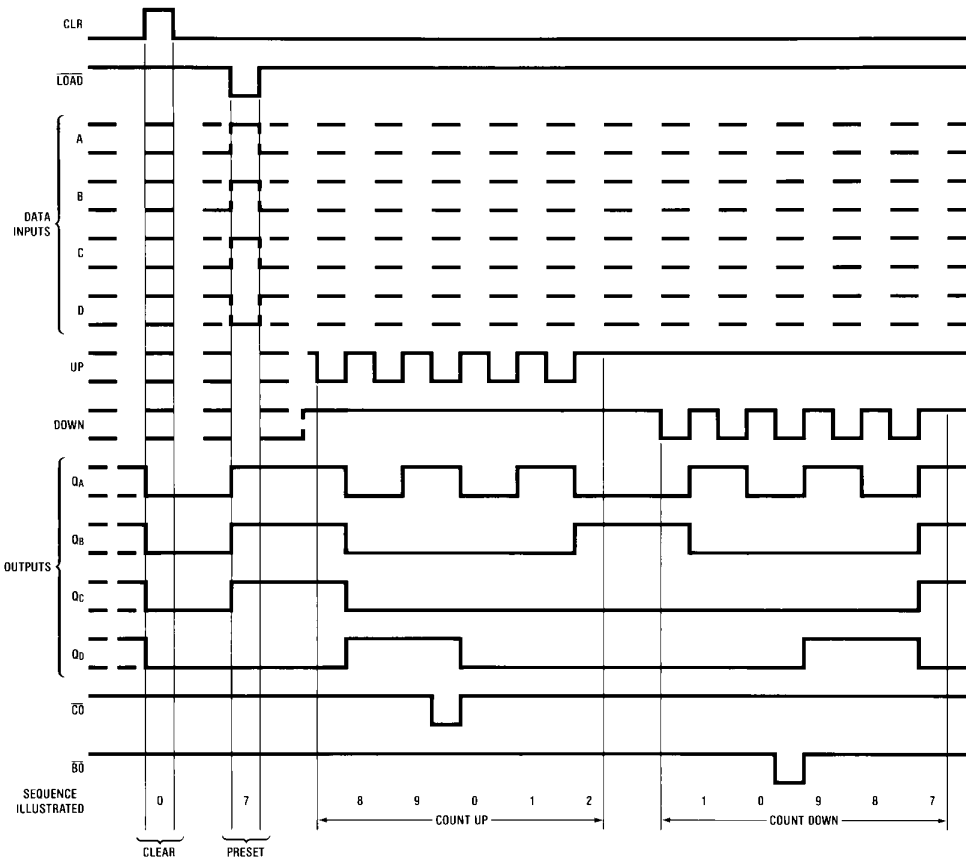


TL/F/6209-3

Pin numbers shown are for J and N packages.

# Timing Diagrams

'ALS192 Typical Clear, Load and Count Sequences



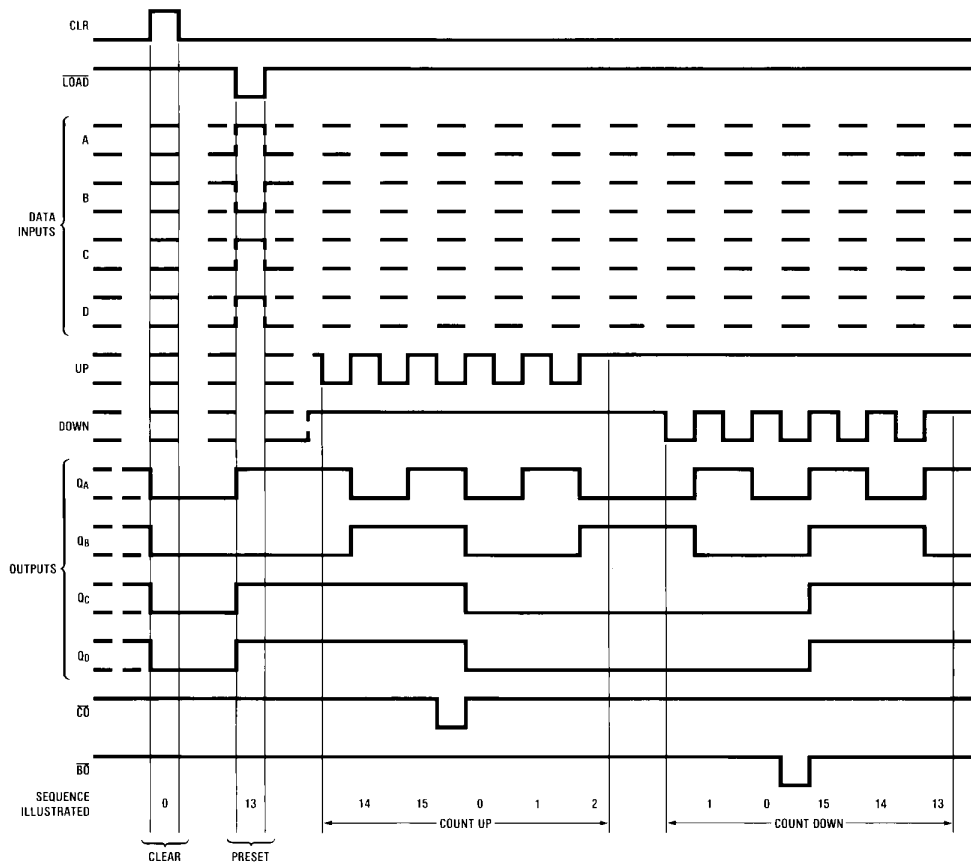
TL/F/6209-4

**Note A:** Clear overrides load, data, and count inputs.

**Note B:** When counting up, count-down input must be high; when counting down, count-up input must be high.

## Timing Diagrams (Continued)

'ALS193 Typical Clear, Load and Count Sequences



TL/F/6209-5

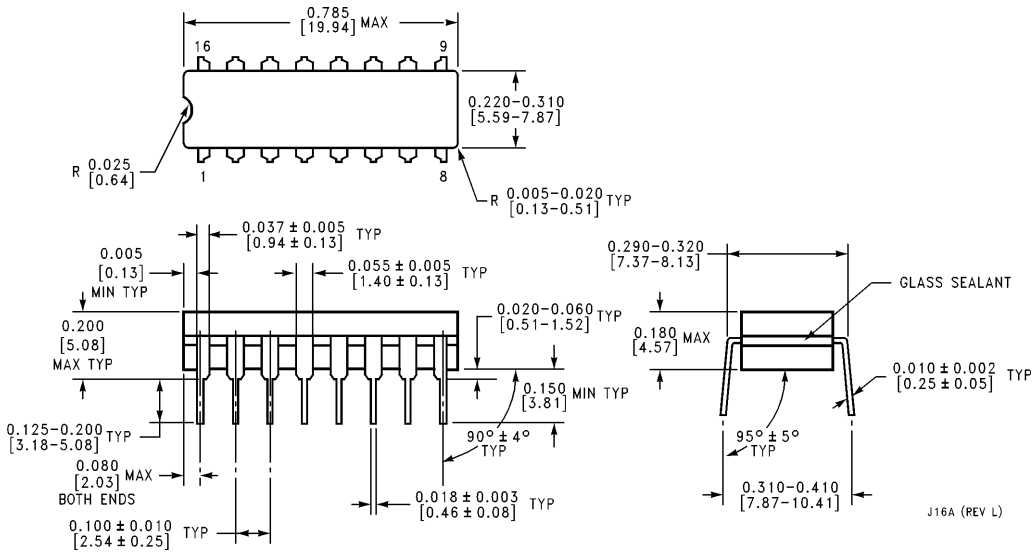
**Note A:** Clear overrides load, data, and count inputs.

**Note B:** When counting up, count-down input must be high; when counting down, count-up input must be high.

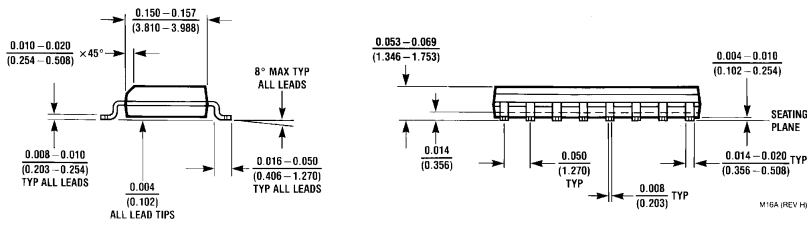
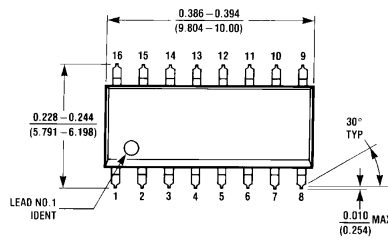




**Physical Dimensions** inches (millimeters)



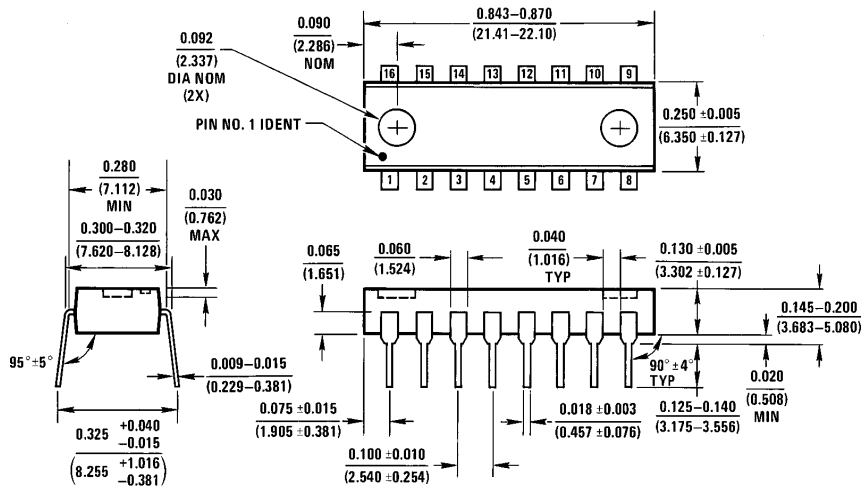
**Ceramic Dual-In-Line Package (J)**  
Order Number DM54ALS192J, 193J  
NS Package Number J16A



**S.O. Package (M)**  
Order Number DM74ALS192M, 193M  
NS Package Number M16A

**DM54ALS192/DM74ALS192/DM54ALS193/DM74ALS193  
Synchronous Four-Bit Up/Down Counters (Dual Clock with Clear)**

**Physical Dimensions** inches (millimeters) (Continued)



**Molded Dual-In-Line Package (N)**  
**Order Number DM74ALS192N, 193N**  
**NS Package Number N16A**

N16A (REV E)

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