

## DM74ALS161B, 162B, 163B Synchronous Four-Bit Counter

### General Description

These synchronous presettable counters feature an internal carry look ahead for application in high speed counting designs. The 'ALS162B is a four-bit decade counter, while the 'ALS161B and 'ALS163B are four-bit binary counters. The 'ALS161B clears asynchronously, while the 'ALS162B and 'ALS163B clear synchronously. The carry output is decoded to prevent spikes during normal counting mode of operation. Synchronous operation is provided by having all flip-flops clocked simultaneously so that outputs change coincident with each other when so instructed by count enable inputs and internal gating. This mode of operation eliminates the output counting spikes which are normally associated with asynchronous (ripple clock) counters. A buffered clock input triggers the four flip-flops on the rising (positive-going) edge of the clock input waveform.

These counters are fully programmable, that is, the outputs may be preset to either level. As presetting is synchronous, setting up a low level at the load input disables the counter and causes the outputs to agree with set up data after the next clock pulse regardless of the levels of enable input. Low to high transitions at the load input are perfectly acceptable regardless of the logic levels on the clock or enable inputs.

The 'ALS161B clear function is asynchronous. A low level at the clear input sets all four of the flip-flop outputs low regardless of the levels of clock, load or enable inputs. These two counters are provided with a clear on power-up feature. The 'ALS162B and 'ALS163B clear function is synchronous; and a low level at the clear input sets all four of the flip-flop outputs low after the next clock pulse, regardless of the levels of enable inputs. This synchronous clear allows the count length to be modified easily, as decoding the maximum count desired can be accomplished with one external NAND gate. The gate output is connected to the clear input to synchronously clear the counter to all low outputs. Low to high transitions at the clear input of the 'ALS162B and 'ALS163B are also permissible regardless of the levels of logic on the clock, enable or load inputs.

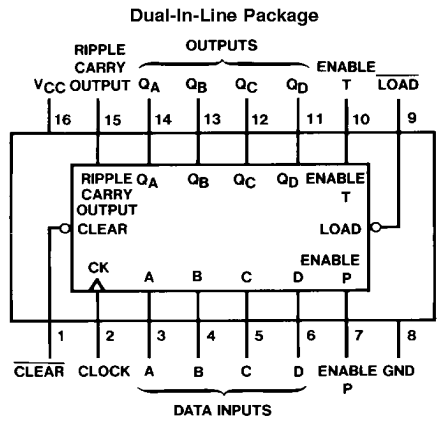
The carry look ahead circuitry provides for cascading counters for n bit synchronous application without additional gating. Instrumental in accomplishing this function are two count enable inputs (P and T) and a ripple carry output. Both count enable inputs must be high to count. The T input is fed forward to enable the ripple carry output. The ripple carry output thus enabled will produce a high level output pulse with a duration approximately equal to the high level portion of QA output. This high level overflow ripple carry pulse can be used to enable successive cascaded stages. High to low level transitions at the enable P or T inputs of the 'ALS161B through 'ALS163B may occur regardless of the logic level on the clock.

The 'ALS161B through 'ALS163B feature a fully independent clock circuit. changes made to control inputs (enable P or T, or load) that will modify the operating mode will have no effect until clocking occurs. The function of the counter (whether enabled, disabled, loading or counting) will be dictated solely by the conditions meeting the stable set-up and hold times.

### 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 counterpart
- Improved AC performance over Schottky and low power Schottky counterparts
- Synchronously programmable
- Internal look ahead for fast counting
- Carry output for n-bit cascading
- Synchronous counting
- Load control line
- ESD inputs

## Connection Diagram



DS006206-1

Order Number DM74ALS161BM, 162BM, 163BM  
or DM74ALS161BN, 162BN, 163BN  
See Package Number M16A or N16A

**Absolute Maximum Ratings** (Note 1)

Supply Voltage	7V
Input Voltage	7V
Operating Free Air Temperature Range	0°C to +70°C
DM74ALS	

Storage Temperature Range

-65°C to +150°C

Typical  $\theta_{JA}$ 

N Package

78.1°C/W

M Package

106.8°C/W

**Recommended Operating Conditions**

Symbol	Parameter		161B, 162B, 163B			Units
			Min	Nom	Max	
$V_{CC}$	Supply Voltage		4.5	5	5.5	V
$V_{IH}$	High Level Input Voltage		2			V
$V_{IL}$	Low Level Input Voltage				0.8	V
$I_{OH}$	High Level Output Current				-0.4	mA
$I_{OL}$	Low Level Output Current				8	mA
$f_{CLK}$	Clock Frequency		0		40	MHz
$t_{SETUP}$	Setup Time	Data; A, B, C, D	15 $\uparrow$ (Note 2)			ns
		En P, En T	15 $\uparrow$ (Note 2)			ns
		ALS161B	15 $\uparrow$ (Note 2)			ns
		ALS162B/163B	15 $\uparrow$ (Note 2)			ns
		Load	15 $\uparrow$ (Note 2)			ns
		Clear (Only for 162B and 163B)	15 $\uparrow$ (Note 2)			ns
		Low	12 $\uparrow$ (Note 2)			ns
$t_{HOLD}$	Hold Time	Data; A, B, C, D	0 $\uparrow$ (Note 2)	-3		ns
		En P, En T	0 $\uparrow$ (Note 2)	-3		ns
		Load	0 $\uparrow$ (Note 2)	-4		ns
		Clear (Only for 162B and 163B)	0 $\uparrow$ (Note 2)	-7		ns
	Hold 0 (Only for 161B)	Clear	0	-4		ns
$t_w$	Width of Clock	CLK High or Low	12.5			ns
	or Clear Pulse	ALS161B CLR Low	15			ns
	Width of Load Pulse		15			ns
$T_A$	Operating Free Air Temperature		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.

**Note 2:** The symbol ( $\uparrow$ ) indicates that the rising edge of the clock is used as a reference.

**Electrical Characteristics**

over recommended operating free air temperature range. All typical values are measured at  $V_{CC} = 5V$ ,  $T_A = 25^\circ C$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$V_{IK}$	Input Clamp Voltage	$V_{CC} = 4.5V$ , $I_I = -18\text{ mA}$			-1.5	V
$V_{OH}$	High Level Output Voltage	$I_{OH} = -0.4\text{ mA}$ $V_{CC} = 4.5V$ to $5.5V$	$V_{CC} - 2$			V
$V_{OL}$	Low Level Output Voltage	$V_{CC} = 4.5V$		0.25	0.4	V
		$I_{OL} = 4\text{ mA}$ $I_{OL} = 8\text{ mA}$		0.35	0.5	V
$I_I$	Input Current at Max Input Voltage	$V_{CC} = 5.5V$ , $V_{IH} = 7V$			0.1	mA
$I_{IH}$	High Level Input Current	$V_{CC} = 5.5V$ , $V_{IH} = 2.7V$			20	$\mu A$
$I_{IL}$	Low Level Input Current	$V_{CC} = 5.5V$ , $V_{IL} = 0.4V$			-0.2	mA
$I_O$	Output Drive Current	$V_{CC} = 5.5V$ , $V_O = 2.25V$	-30		-112	mA
$I_{CC}$	Supply Current	$V_{CC} = 5.5V$		12	21	mA

## Switching Characteristics

over recommended operating free air temperature range. (Note 3)

Symbol	Parameter	Conditions	From	To	161B		Units
					Min	Max	
$f_{MAX}$	Max. Clock Freq.	$V_{CC} = 4.5V$ to 5.5V $R_L = 500\Omega$ $C_L = 50 \text{ pF}$			40		MHz
$t_{PLH}$	Propagation Delay Time Low to High Level Output		Clock	Ripple Carry	5	20	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output		Clock	Ripple Carry	5	20	ns
$t_{PLH}$	Propagation Delay Time Low to High Level Output		Clock	Any Q	4	15	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output		Clock	Any Q	6	20	ns
$t_{PLH}$	Propagation Delay Time Low to High Level Output		En T	Ripple Carry	3	13	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output		En T	Ripple Carry	3	13	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output		Clear	Any Q	8	24	ns
			Clear	Ripple Carry	11	23	ns

**Note 3:** See Section 5 for test waveforms and output load.

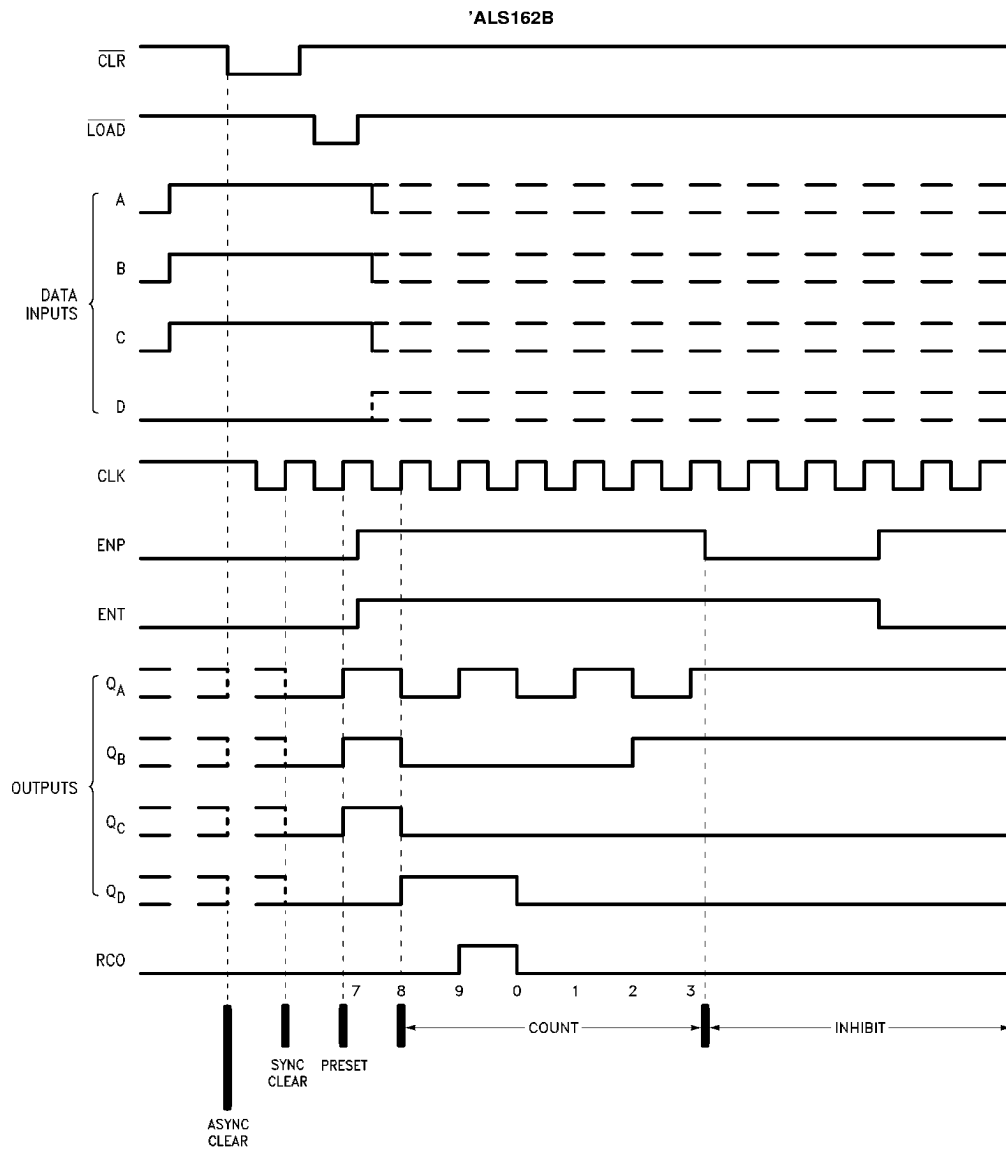
## 'ALS162B, 'ALS163B Switching Characteristics

over recommended operating free air temperature range. (Note 4)

Symbol	Parameter	Conditions	From	To	162B, 163B		Units
					Min	Max	
$f_{MAX}$	Max. Clock Freq.	$V_{CC} = 4.5V$ to 5.5V $R_L = 500\Omega$ $C_L = 50 \text{ pF}$ $T_A = \text{Min}$ to Max			40		MHz
$t_{PLH}$	Propagation Delay Time Low to High Level Output		Clock	Ripple Carry	5	20	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output		Clock	Ripple Carry	5	20	ns
$t_{PLH}$	Propagation Delay Time Low to High Level Output		Clock	Any Q	4	15	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output		Clock	Any Q	6	20	ns
$t_{PLH}$	Propagation Delay Time Low to High Level Output		En T	Ripple Carry	3	13	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output		En T	Ripple Carry	3	13	ns

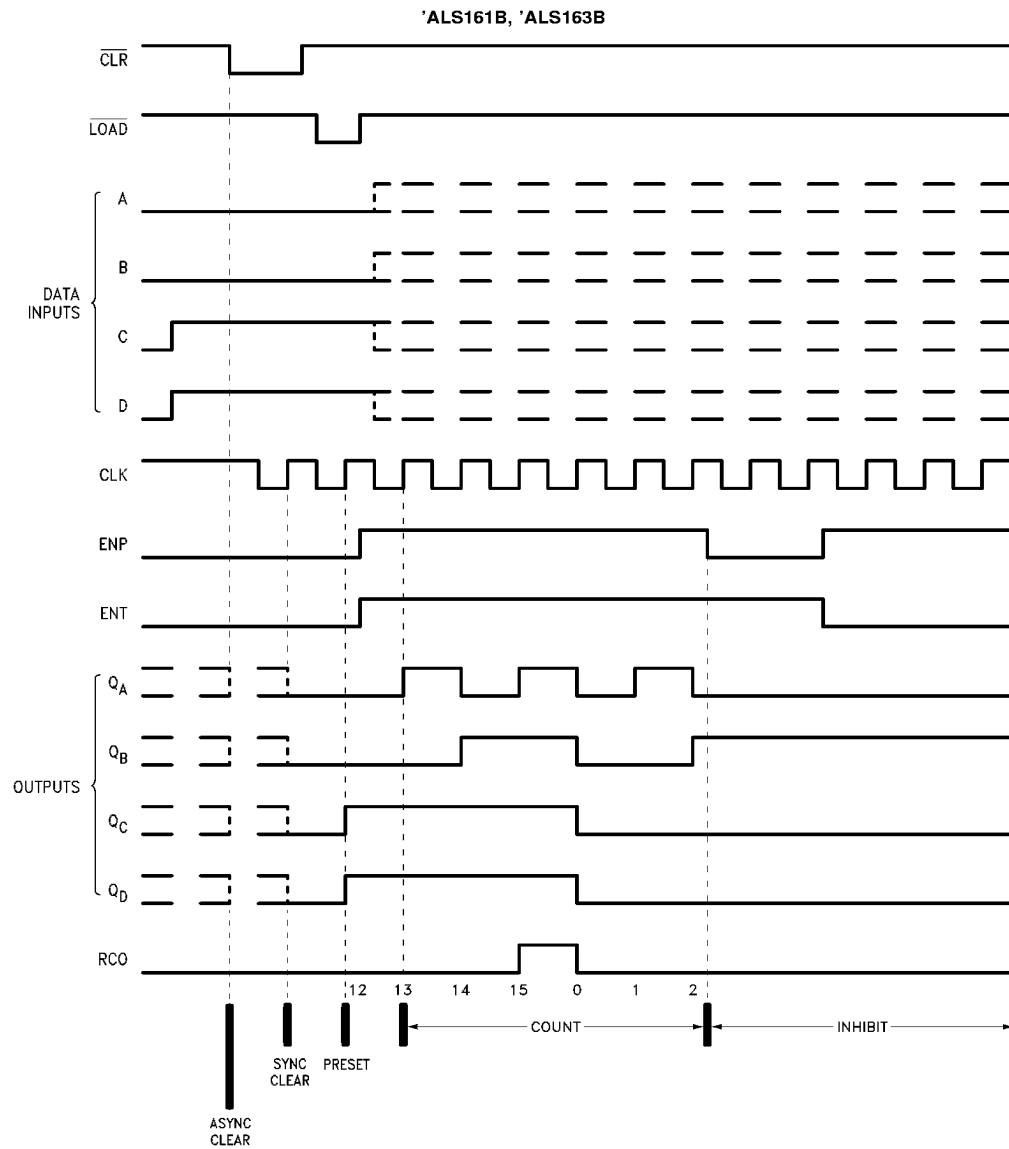
**Note 4:** See Section 5 for test waveforms and output load.

## Timing Diagrams



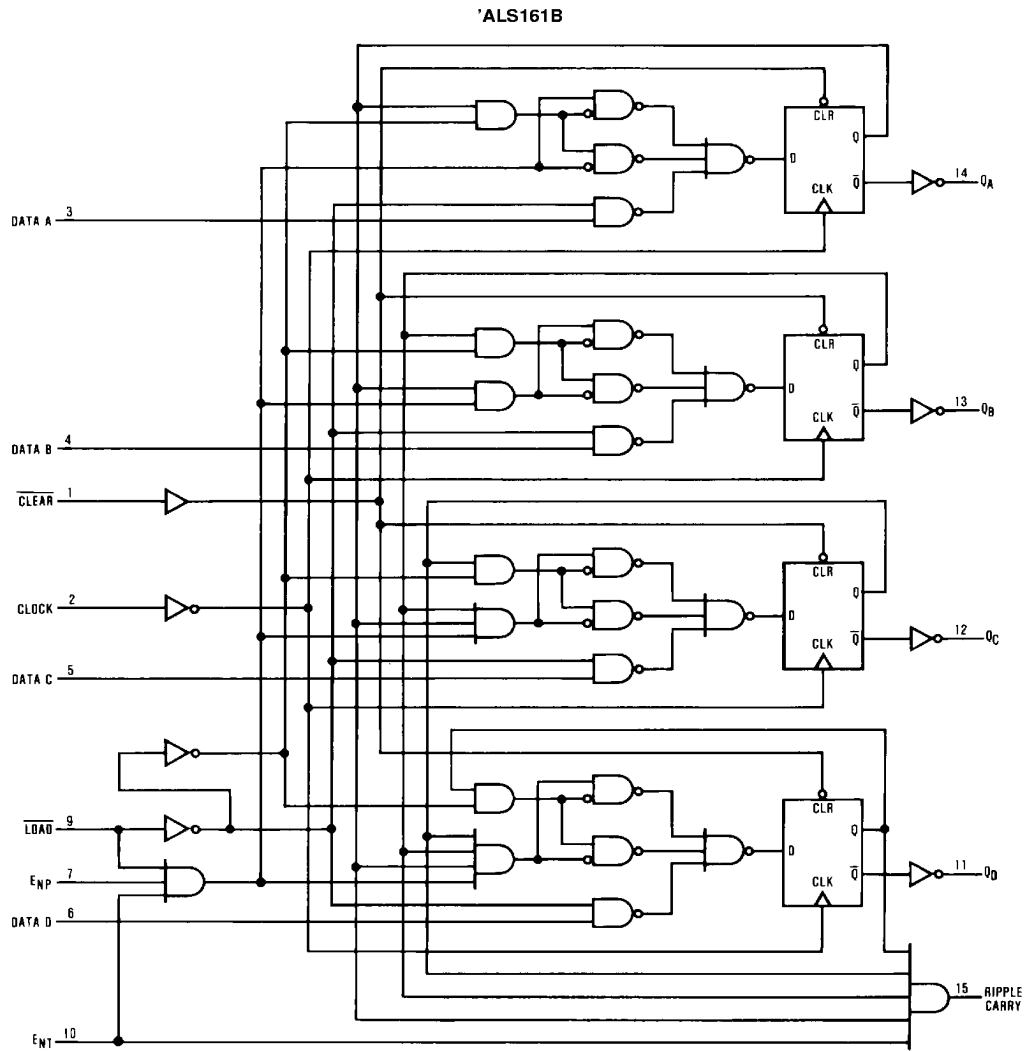
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## Timing Diagrams (Continued)



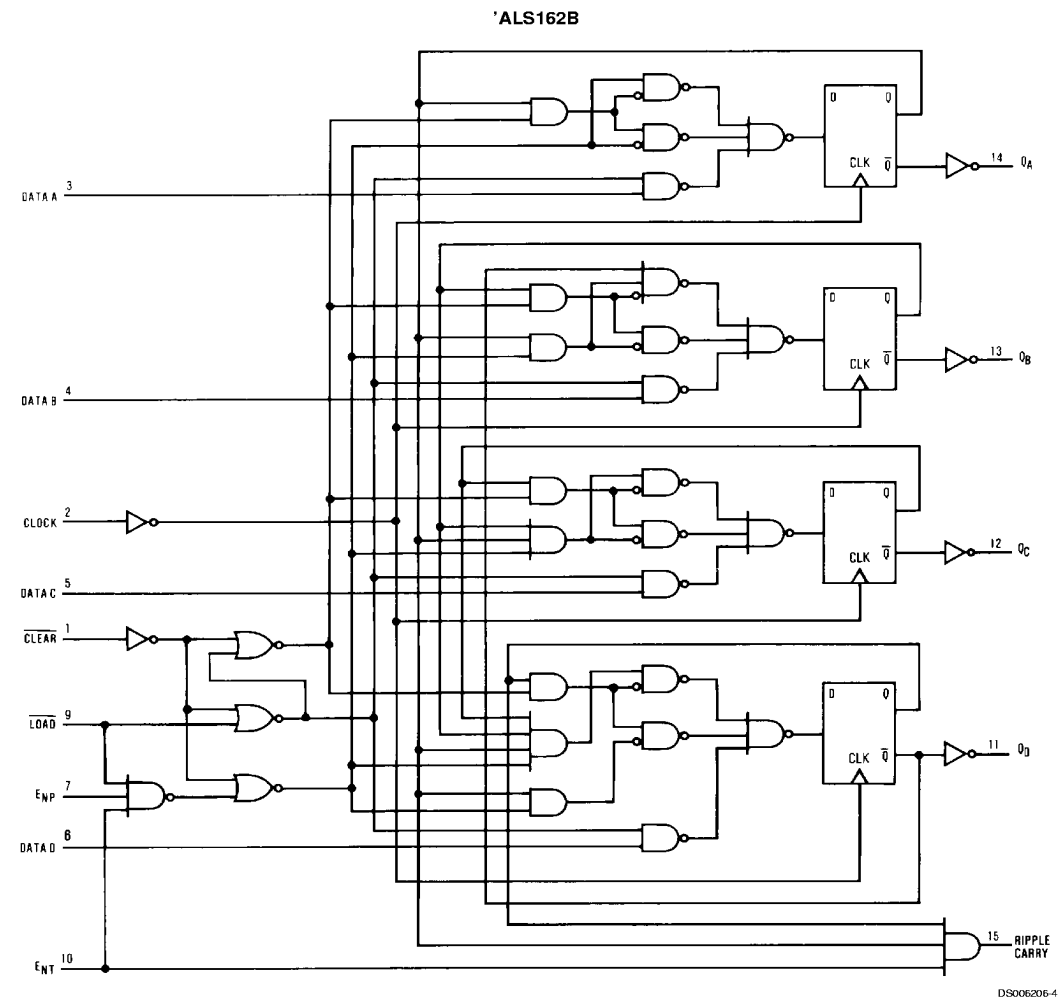
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## Logic Diagrams

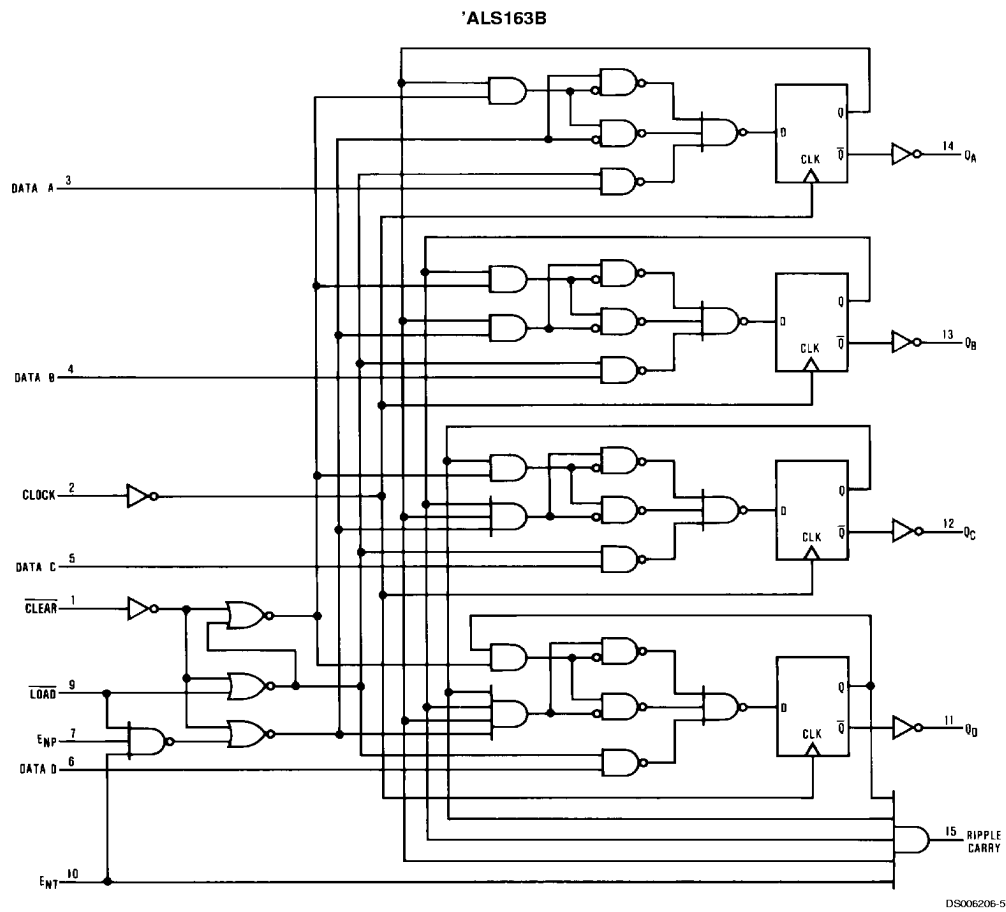


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## Logic Diagrams (Continued)

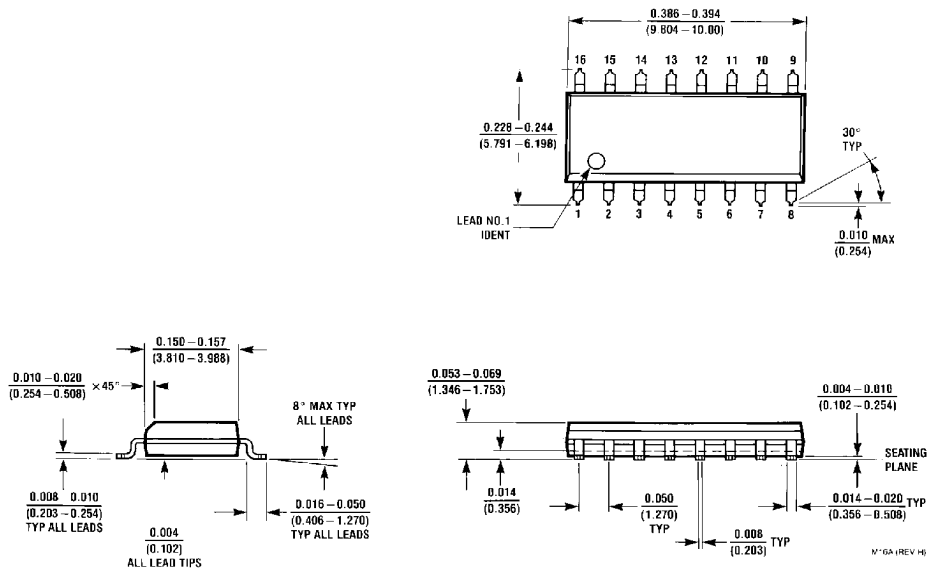


## Logic Diagrams (Continued)

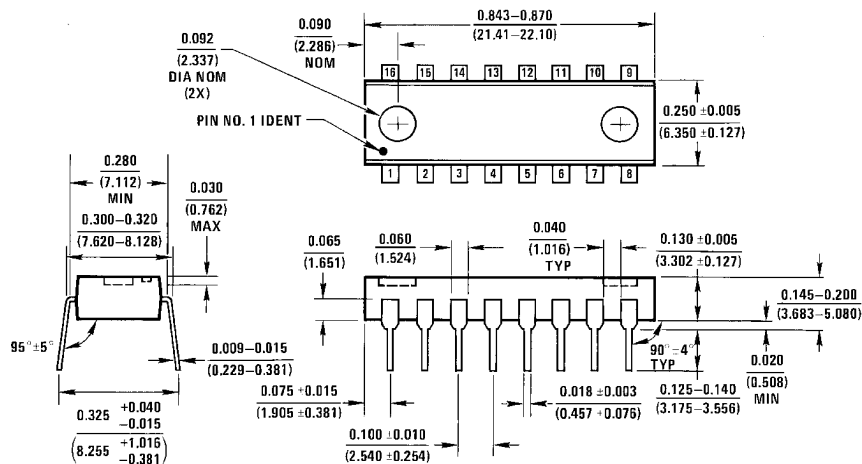




**Physical Dimensions** inches (millimeters) unless otherwise noted



**Small Outline Package (M)**  
 Order Number DM74ALS161BM, 162BM or 163BM  
 Package Number M16A



**Molded Dual-In-Line Package (N)**  
 Order Number DM74ALS161BN, 162BN or 163BN  
 Package Number N16A