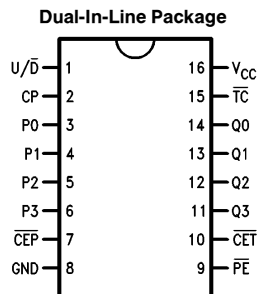


54LS168 Synchronous Bi-Directional BCD Decade Counter

General Description

The 54LS168 is a fully synchronous 4-state up/down counter featuring a preset capability for programmable operation, carry lookahead for easy cascading and a U/\bar{D} input to control the direction of counting. It counts in the BCD (8421) sequence and all state changes, whether in counting or parallel loading, are initiated by the LOW-to-HIGH transition of the clock.

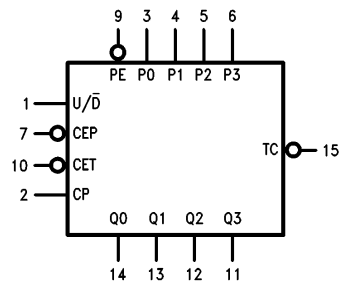
Connection Diagram



TL/F/10207-1

**Order Number 54LS168DMQB,
54LS168FMQB or 54LS168LMQB
See NS Package Number
E20A, J16A or W16A**

Logic Symbol



V_{CC} = Pin 16
GND = Pin 8

TL/F/10207-2

Pin Names	Description
\overline{CEP}	Count Enable Parallel Input (Active LOW)
\overline{CET}	Count Enable Trickle Input (Active LOW)
CP	Clock Pulse Input (Active Rising Edge)
P0-P3	Parallel Data Inputs
\overline{PE}	Parallel Enable Input (Active LOW)
U/\bar{D}	Up-Down Count Control Input
Q0-Q3	Flip-Flop Outputs
\overline{TC}	Terminal Count Output (Active LOW)

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	
54LS	–55°C to +125°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	54LS168			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			0.7	V
I _{OH}	High Level Output Current			–0.4	mA
I _{OL}	Low Level Output Current			4	mA
T _A	Free Air Operating Temperature	–55		125	°C
t _s (H)	Setup Time HIGH or LOW	15			ns
t _s (L)	P _n , \overline{CEP} or \overline{CET} to CP	15			
t _h (H)	Hold Time HIGH or LOW	5			ns
t _h (L)	P _n , \overline{CEP} or \overline{CET} to CP	5			
t _s (H)	Setup Time HIGH or LOW	20			ns
t _s (L)	\overline{PE} to CP	20			
t _h (H)	Hold Time HIGH or LOW	0			ns
t _h (L)	\overline{PE} to CP	0			
t _s (H)	Setup Time HIGH or LOW	25			ns
t _s (L)	U/ \overline{D} to CP	25			
t _h (H)	Hold Time HIGH or LOW	0			ns
t _h (L)	U/ \overline{D} to CP	0			
t _w (H)	CP Pulse Width HIGH or LOW	20			ns
t _w (L)		20			

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	$V_{CC} = \text{Min}, I_I = -18 \text{ mA}$			-1.5	V
V_{OH}	High Level Output Voltage	$V_{CC} = \text{Min}, I_{OH} = \text{Max}, V_{IL} = \text{Max}, V_{IH} = \text{Min}$	2.5			V
V_{OL}	Low Level Output Voltage	$V_{CC} = \text{Min}, I_{OL} = \text{Max}, V_{IH} = \text{Min}, V_{IL} = \text{Max}$			0.4	V
I_I	Input Current @ Max Input Voltage	$V_{CC} = \text{Max}, V_I = 10.0\text{V}$			0.1	mA
I_{IH}	High Level Input Current	$V_{CC} = \text{Max}, V_I = 2.7\text{V}$	Inputs		20	μA
			$\overline{\text{CET}}$		40	
I_{IL}	Low Level Input Current	$V_{CC} = \text{Max}, V_I = 0.5\text{V}$	Data	-0.5	-400	μA
			CP, $\overline{\text{PE}}$, U/ $\overline{\text{D}}$, $\overline{\text{CEP}}$	-30	-400	
			$\overline{\text{CET}}$	-60	-800	
I_{OS}	Short Circuit Output Current	$V_{CC} = \text{Max}$ (Note 2)	-20		-100	mA
I_{CC}	Supply Current	$V_{CC} = \text{Max}$ (Note 3)			34	mA

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

Note 2: Not more than one output should be shorted at a time, and the duration should not exceed one second.

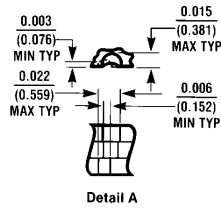
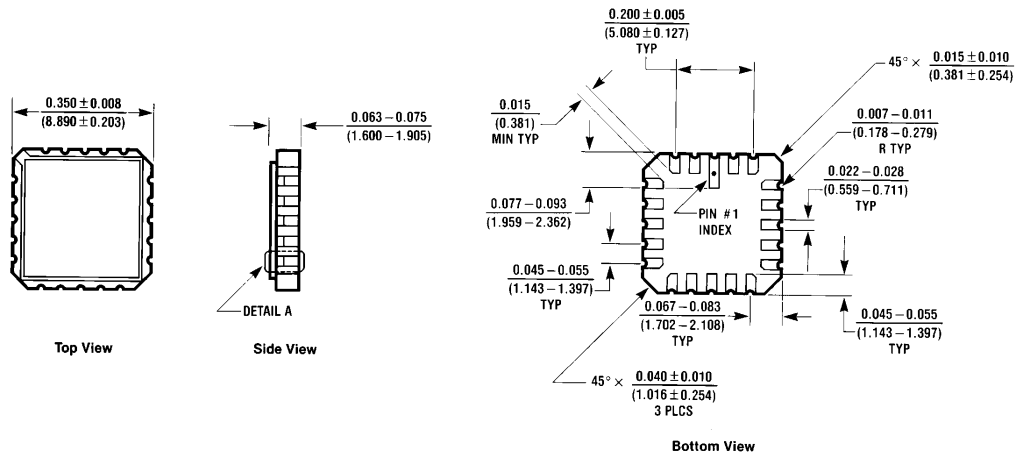
Note 3: I_{CC} is measured with all outputs open and all inputs grounded.

Switching Characteristics

$V_{CC} = +5.0\text{V}, T_A = +25^\circ\text{C}$ (See Section 1 for test waveforms and output load)

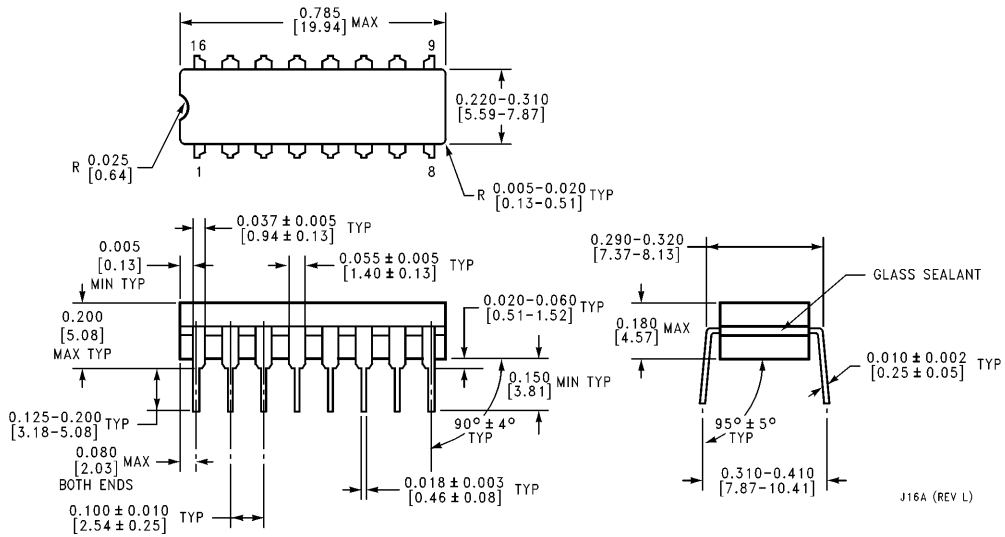
Symbol	Parameter	54LS168		Units
		$C_L = 15 \text{ pF}$		
		Min	Max	
f_{Max}	Maximum Clock Frequency	25		MHz
t_{PLH} t_{PHL}	Propagation Delay CP to Q_n		20 20	ns
t_{PLH} t_{PHL}	Propagation Delay CP to $\overline{\text{TC}}$		30 30	ns
t_{PLH} t_{PHL}	Propagation Delay $\overline{\text{CET}}$ to $\overline{\text{TC}}$		15 20	ns
t_{PLH} t_{PHL}	Propagation Delay U/ $\overline{\text{D}}$ to $\overline{\text{TC}}$		25 25	ns

Physical Dimensions inches (millimeters)



Ceramic Leadless Chip Carrier Package (E)
Order Number 54LS168LMQB
NS Package Number E20A

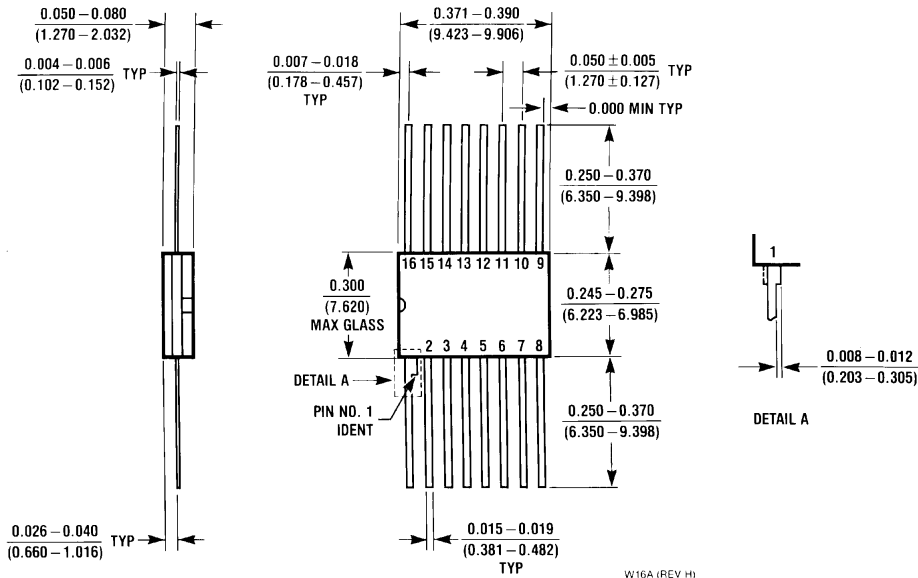
E20A (REV D)



16-Lead Ceramic Dual-In-Line Package (J)
Order Number 54LS168DMQB
NS Package Number J16A

J16A (REV L)

Physical Dimensions inches (millimeters) (Continued)



16-Lead Ceramic Flat Package (W)
Order Number 54LS168FMQB
NS Package Number W16A

W16A (REV. H)

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