National Semiconductor

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54LS109/DM54LS109A/DM74LS109A Dual Positive-Edge-Triggered J-$\overline{K}$ Flip-Flops with Preset, Clear, and Complementary Outputs

General Description

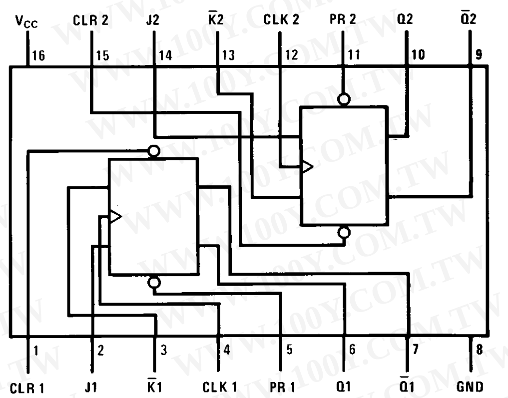
This device contains two independent positive-edge-triggered J-$\overline{K}$ flip-flops with complementary outputs. The J and $\overline{K}$ data is accepted by the flip-flop on the rising edge of the clock pulse. The triggering occurs at a voltage level and is not directly related to the transition time of the rising edge of the clock. The data on the J and $\overline{K}$ inputs may be changed while the clock is high or low as long as setup and hold times are not violated. A low logic level on the preset or clear inputs will set or reset the outputs regardless of the logic levels of the other inputs.

Features

- Alternate Military/Aerospace device (54LS109) is available. Contact a National Semiconductor Sales Office/Distributor for specifications

Connection Diagram

Dual-In-Line Package



TL/F/6368–1

Order Number 54LS109DMQB, 54LS109FMQB, DM54LS109AJ, DM54LS109AW, DM74LS109AM or DM74LS109AN
See NS Package Number J16A, M16A, N16E or W16A

Function Table

Inputs					Outputs	
PR	CLR	CLK	J	$\overline{K}$	Q	$\overline{Q}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H*	H*
H	H	↑	L	L	L	H
H	H	↑	H	L	Toggle	
H	H	↑	L	H	Q_0	$\overline{Q}_0$
H	H	↑	H	H	H	L
H	H	L	X	X	Q_0	$\overline{Q}_0$

H = High Logic Level
L = Low Logic Level
X = Either Low or High Logic Level
↑ = Rising Edge of Pulse
* = This configuration is nonstable; that is, it will not persist when preset and/or clear inputs return to their inactive (high) state.
Q_0 = The output logic level of Q before the indicated input conditions were established.
Toggle = Each output changes to the complement of its previous level on each active transition of the clock pulse.

 TL/F/6368 RRD-B30M105/Printed in U. S. A.

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	7V
Operating Free Air Temperature Range	
DM54LS and 54LS	−55°C to +125°C
DM74LS	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		DM54LS109A			DM74LS109A			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				0.7			0.8	V
I_{OH}	High Level Output Current				−0.4			−0.4	mA
I_{OL}	Low Level Output Current				4			8	mA
f_{CLK}	Clock Frequency (Note 2)		0		25	0		25	MHz
f_{CLK}	Clock Frequency (Note 3)		0		20	0		20	MHz
t_W	Pulse Width (Note 2)	Clock High	18			18			ns
		Preset Low	15			15			
		Clear Low	15			15			
t_W	Pulse Width (Note 3)	Clock High	25			25			ns
		Preset Low	20			20			
		Clear Low	20			20			
t_{SU}	Setup Time (Notes 1 & 2)	Data High	30 ↑			30 ↑			ns
		Data Low	20 ↑			20 ↑			
t_{SU}	Setup Time (Notes 1 & 3)	Data High	35 ↑			35 ↑			ns
		Data Low	25 ↑			25 ↑			
t_H	Hold Time (Note 4)		0 ↑			0 ↑			ns
T_A	Free Air Operating Temperature		−55		125	0		70	°C

Note 1: The symbol (↑) indicates the rising edge of the clock pulse is used for reference.

Note 2: $C_L = 15$ pF, $R_L = 2$ kΩ, $T_A = 25°C$ and $V_{CC} = 5V$.

Note 3: $C_L = 50$ pF, $R_L = 2$ kΩ, $T_A = 25°C$ and $V_{CC} = 5V$.

Note 4: $T_A = 25°C$ and $V_{CC} = 5V$.

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 = −18 mA				−1.5	V
V_{OH}	High Level Output Voltage	V_{CC} = Min, I_{OH} = Max V_{IL} = Max, V_{IH} = Min	DM54	2.5	3.4		V
			DM74	2.7	3.4		
V_{OL}	Low Level Output Voltage	V_{CC} = Min, I_{OL} = Max V_{IL} = Max, V_{IH} = Min	DM54		0.25	0.4	V
			DM74		0.35	0.5	
		I_{OL} = 4 mA, V_{CC} = Min	DM74		0.25	0.4	
I_I	Input Current @ Max Input Voltage	V_{CC} = Max V_I = 7V	J, $\overline{K}$			0.1	mA
			Clock			0.1	
			Preset			0.2	
			Clear			0.2	
I_{IH}	High Level Input Current	V_{CC} = Max V_I = 2.7V	J,$\overline{K}$			20	μA
			Clock			20	
			Preset			40	
			Clear			40	
I_{IL}	Low Level Input Current	V_{CC} = Max V_I = 0.4V	J, $\overline{K}$			−0.4	mA
			Clock			−0.4	
			Preset			−0.8	
			Clear			−0.8	
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 2)	DM54	−20		−100	mA
			DM74	−20		−100	
I_{CC}	Supply Current	V_{CC} = Max (Note 3)			4	8	mA

Switching Characteristics at V_{CC} = 5V and T_A = 25°C (See Section 1 for Test Waveforms and Output Load)

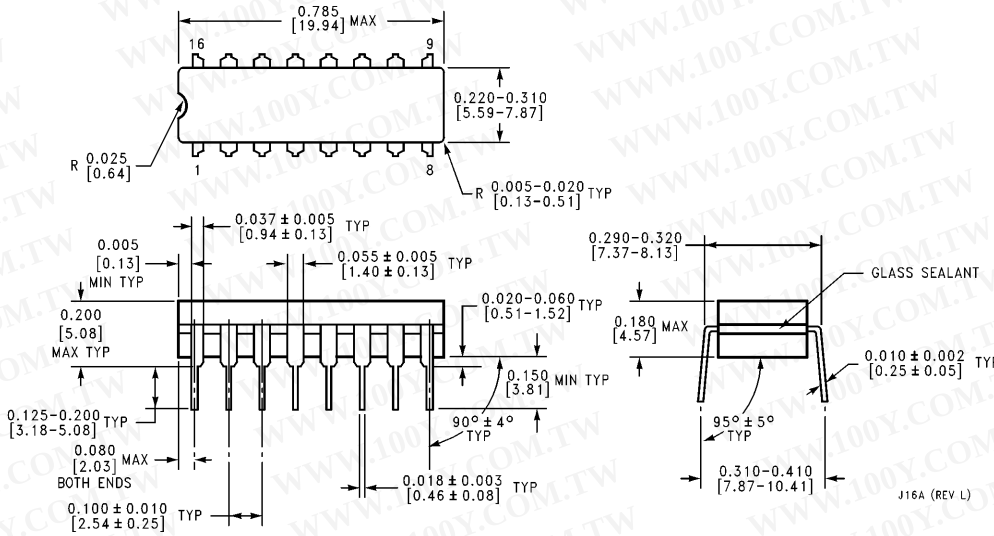
Symbol	Parameter	From (Input) To (Output)	R_L = 2 kΩ				Units
			C_L = 15 pF		C_L = 50 pF		
			Min	Max	Min	Max	
f_{MAX}	Maximum Clock Frequency		25		20		MHz
t_{PLH}	Propagation Delay Time Low to High Level Output	Clock to Q or $\overline{Q}$		25		35	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Clock to Q or $\overline{Q}$		30		35	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	Clear to $\overline{Q}$		25		35	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Clear to Q		30		35	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	Preset to Q		25		35	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Preset to $\overline{Q}$		30		35	ns

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, and the duration should not exceed one second. For devices, with feedback from the outputs, where shorting the outputs to ground may cause the outputs to change logic state an equivalent test may be performed where V_O = 2.25V and 2.125V for DM54 and DM74 series, respectively, with the minimum and maximum limits reduced by one half from their stated values. This is very useful when using automatic test equipment.

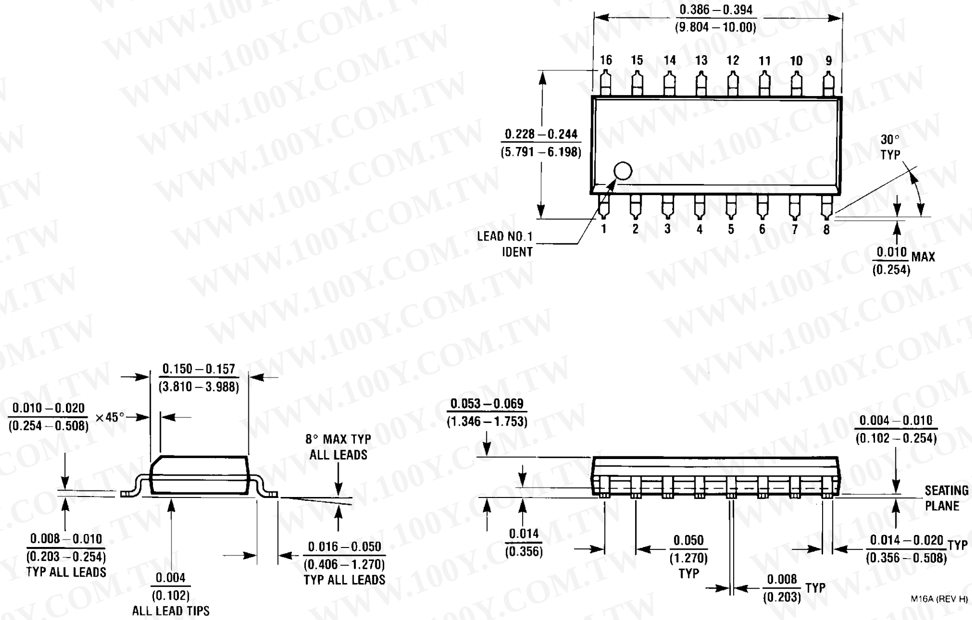
Note 3: I_{CC} is measured with all outputs open, with CLOCK grounded after setting the Q and $\overline{Q}$ outputs high in turn.

Physical Dimensions inches (millimeters)

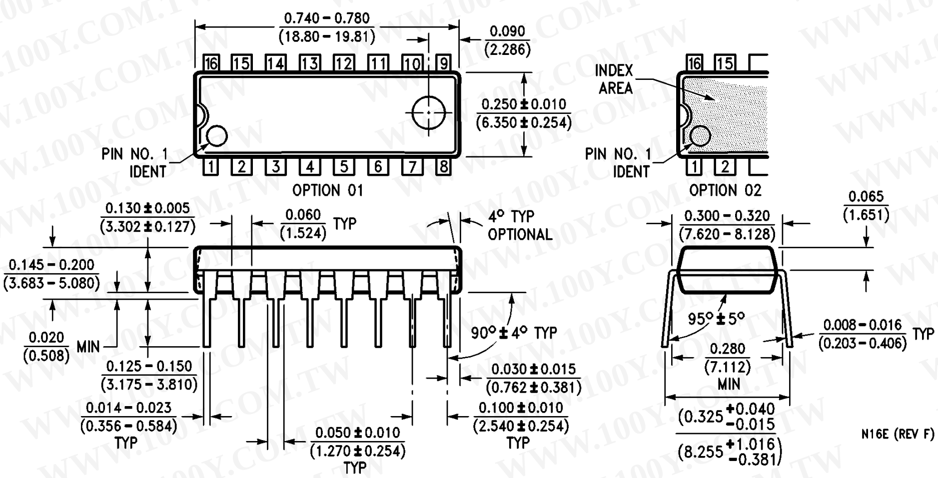


16-Lead Ceramic Dual-In-Line Package (J)
Order Number 54LS109DMQB or DM54LS109AJ
NS Package Number J16A

Physical Dimensions inches (millimeters) (Continued)

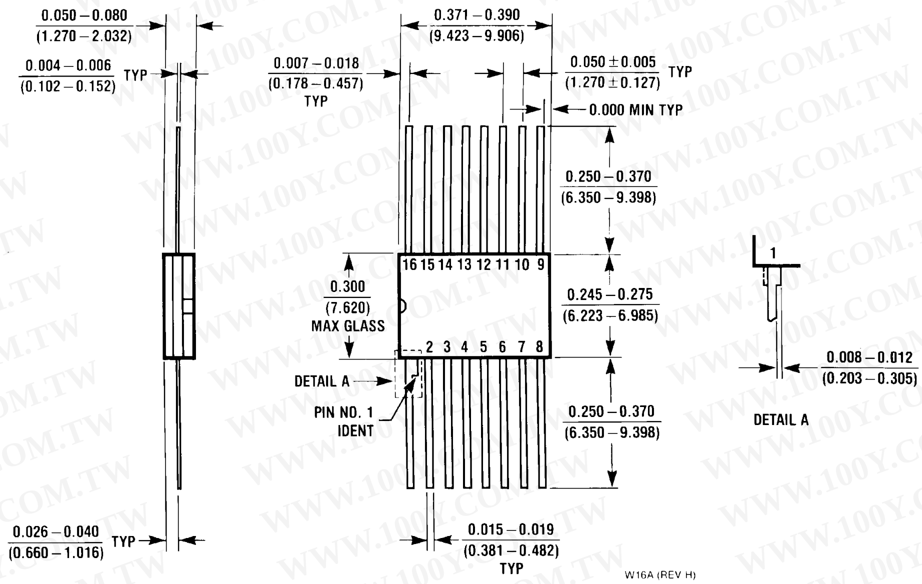


16-Lead Small Outline Molded Package (M)
Order Number DM74LS109AM
NS Package Number M16A



16-Lead Molded Dual-In-Line Package (N)
Order Number DM74LS109AN
NS Package Number N16E

Physical Dimensions inches (millimeters) (Continued)



16-Lead Ceramic Flat Package
Order Number 54LS109FMQB or DM54LS109AW
NS Package Number W16A

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