National Semiconductor

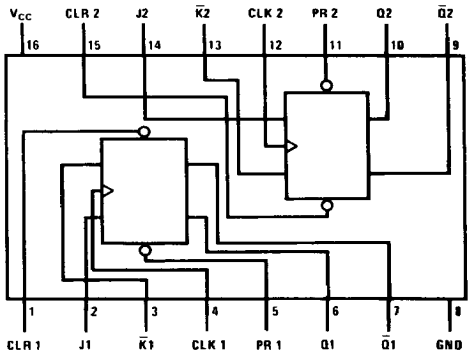
DM54109 Dual Positive-Edge-Triggered J-$\overline{K}$ Flip-Flops with Preset, Clear, and Complementary Outputs

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.

Connection Diagram

Dual-In-Line Package



TL/F/6537–1

Order Number DM54109J or DM54109W
See NS Package Number J16A 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

↑ = Rising Edge of Pulse.

* = This configuration is nonstable; that is, it will not persist when preset and clear inputs return to their inactive (high) level.

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.

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	
DM54	−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		DM54109			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				−1.2	mA
I_{OL}	Low Level Output Current				16	mA
f_{CLK}	Clock Frequency (Note 6)		0		30	MHz
t_W	Pulse Width (Note 6)	Clock High	20			ns
		Clock Low	20			
		Preset Low	20			
		Clear Low	20			
t_{SU}	Input Setup Time (Notes 1 & 6)		15 ↑			ns
t_H	Input Hold Time (Notes 1 & 6)		10 ↓			ns
T_A	Free Air Operating Temperature		−55		125	°C

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			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	J, $\overline{K}$			40	μA
			Preset			80	
			Clock			80	
			Clear			160	
I_{IL}	Low Level Input Current	V_{CC} = Max V_I = 0.4V (Note 5)	J, $\overline{K}$			−1.6	mA
			Preset			−3.2	
			Clock			−3.2	
			Clear			−4.8	
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 3)		−30		−85	mA
I_{CC}	Supply Current	V_{CC} = Max (Note 4)			20	30	mA

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

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: With all outputs open, I_{CC} is measured with the Q and $\overline{Q}$ outputs high in turn. At the time of measurement the clock input grounded.

Note 5: Clear is tested with preset high and preset is tested with clear high.

Note 6: T_A = 25°C and V_{CC} = 5V.

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 = 400Ω, C_L = 15 pF		Units
			Min	Max	
f_{MAX}	Maximum Clock Frequency		30		MHz
t_{PLH}	Propagation Delay Time Low to High Level Output	Preset to Q		14	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Preset to $\overline{Q}$		29	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	Clear to $\overline{Q}$		14	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Clear to Q		25	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	Clock to Q or $\overline{Q}$		18	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Clock to Q or $\overline{Q}$		28	ns