

TC74AC109 Dual J- \bar{K} Flip-Flop with Preset and Clear

Features:

- **High Speed:** $f_{max} = 200\text{MHz}$ (typ.) at $V_{CC} = 5\text{V}$
- **Low Power Dissipation:** $I_{CC} = 4\mu\text{A}$ (max.) at $T_a = 25^\circ\text{C}$
- **High Noise Immunity:** $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (min.)
- **Symmetrical Output Impedance:** $I_{OH} = I_{OL} = 24\text{mA}$ (min.). Capability of driving 50Ω transmission lines.
- **Balanced Propagation Delays:** $t_{pLH} = t_{pHL}$
- **Wide Operating Voltage Range:** $V_{CC}(\text{opr}) = 2\text{V} \sim 5.5\text{V}$
- **Pin and Function Compatible with 74F109**
- **Available in 16-pin DIP and 150 mil SOIC**

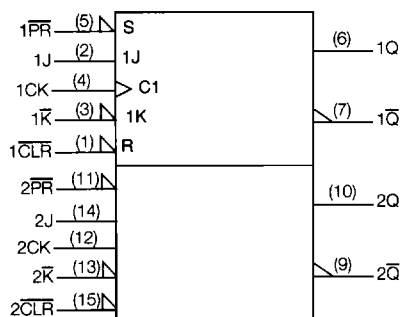
The TC74AC109 is an advanced high speed CMOS DUAL J- \bar{K} FLIP-FLOP fabricated with silicon gate and double-layer metal wiring C²MOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL, while maintaining the CMOS low power dissipation.

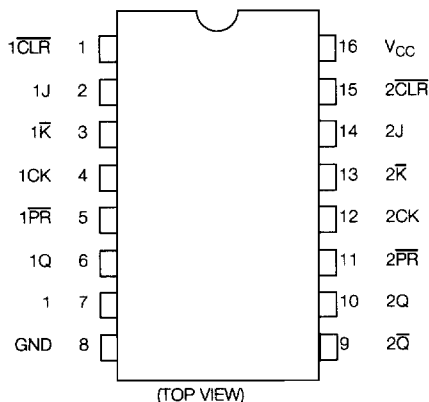
In accordance with the logic level given the J and \bar{K} inputs this device changes state on positive-going transition of the clock pulse. $\overline{\text{CLEAR}}$ and $\overline{\text{PRESET}}$ are independent of the clock and accomplished by a low logic level on the corresponding input.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

IEC Logic Symbol



Pin Assignment



Truth Table

INPUTS					OUTPUTS		FUNCTION
CLR	PR	J	K	CK	Q	Q	
L	H	X	X	X	L	H	CLEAR
H	L	X	X	X	H	L	PRESET
L	L	X	X	X	H	H	—
H	H	L	H	\downarrow	Q_n	\bar{Q}_n	NO CHANGE
H	H	L	L	\downarrow	L	H	—
H	H	H	H	\downarrow	H	L	—
H	H	H	L	\downarrow	\bar{Q}_n	Q_n	TOGGLE
H	H	X	X	\downarrow	Q_n	\bar{Q}_n	NO CHANGE

X: Don't Care

Absolute Maximum Ratings

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage Range	V_{CC}	-0.5-7.0	V
DC Input Voltage	V_{IN}	-0.5- $V_{CC} + 0.5$	V
DC Output Voltage	V_{OUT}	-0.5- $V_{CC} + 0.5$	V
Input Diode Current	I_{IK}	± 20	mA
Output Diode Current	I_{OK}	± 50	mA
DC Output Current	I_{OUT}	± 50	mA
DC V_{CC} /Ground Current	I_{CC}	± 100	mA
Power Dissipation	P_D	500 (DIP) */180 (SOP)	mW
Storage Temperature	T_{stg}	-65-150	°C
Lead Temperature 10sec	T_L	300	°C

* 500mW in the range of $T_a = -40^{\circ}\text{C}$ - 65°C .
From $T_a = 65^{\circ}\text{C}$ to 85°C a derating factor of
-10mW/°C should be applied up to 300mW.

Recommended Operating Conditions

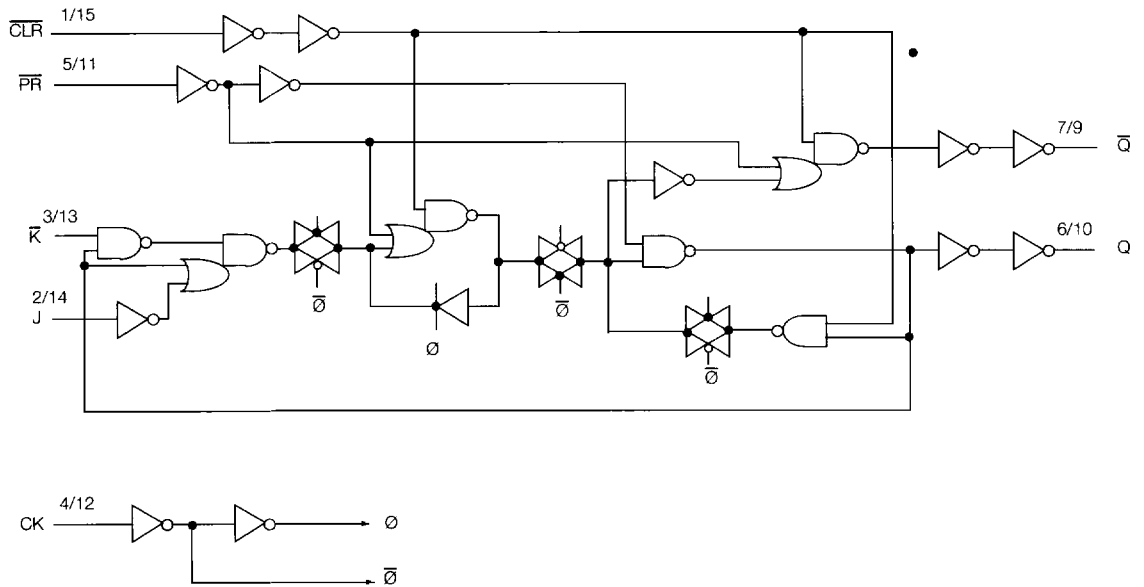
PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	V_{CC}	2.0-5.5	V
Input Voltage	V_{IN}	0- V_{CC}	V
Output Voltage	V_{OUT}	0- V_{CC}	V
Operating Temperature	T_{opr}	-40-85	°C
Input Rise and Fall Time	dt/dv	0-100 ($V_{CC} = 3.3 \pm 0.3\text{V}$) 0-20 ($V_{CC} = 5 \pm 0.5\text{V}$)	ns/v

DC Electrical Characteristics

PARAMETER	SYMBOL	TEST CONDITION	$T_a = 25^{\circ}\text{C}$				$T_a = -40\text{--}85^{\circ}\text{C}$		UNIT	
			V_{CC}	Min.	Typ.	Max.	Min.	Max.		
High-Level Input Voltage	V_{IH}	—	2.0	1.50	—	—	1.50	—	V	
			3.0	2.10	—	—	2.10	—		
			5.5	3.85	—	—	3.85	—		
Low-Level Input Voltage	V_{IL}	—	2.0	—	—	0.50	—	0.50	V	
			3.0	—	—	0.90	—	0.90		
			5.5	—	—	1.65	—	1.65		
High-Level Output Voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -50\mu\text{A}$	2.0	1.9	2.0	—	1.9	—	V
				3.0	2.9	3.0	—	2.9	—	
				4.5	4.4	4.5	—	4.4	—	
				5.5	—	—	—	—	—	
High-Level Output Voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -4\text{mA}$	3.0	2.58	—	—	2.48	—	V
				4.5	3.94	—	—	3.80	—	
				5.5	—	—	—	3.85	—	
				5.5	—	—	—	—	—	
High-Level Output Voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -24\text{mA}$	3.0	—	—	—	—	—	V
				4.5	—	—	—	—	—	
				5.5	—	—	—	—	—	
				5.5	—	—	—	—	—	
High-Level Output Voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -75\text{mA}^*$	3.0	—	—	—	—	—	V
				4.5	—	—	—	—	—	
				5.5	—	—	—	—	—	
				5.5	—	—	—	—	—	
Low-Level Output Voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 50\mu\text{A}$	2.0	—	0.0	0.1	—	0.1	V
				3.0	—	0.0	0.1	—	0.1	
				4.5	—	0.0	0.1	—	0.1	
				3.0	—	—	0.36	—	0.44	
				4.5	—	—	0.36	—	0.44	
Low-Level Output Voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 12\text{mA}$	3.0	—	—	0.36	—	0.44	V
				4.5	—	—	0.36	—	0.44	
				5.5	—	—	—	—	1.65	
				5.5	—	—	—	—	—	
Low-Level Output Voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 24\text{mA}$	3.0	—	—	0.36	—	0.44	V
				4.5	—	—	0.36	—	0.44	
Low-Level Output Voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 75\text{mA}^*$	3.0	—	—	—	—	—	V
				4.5	—	—	—	—	—	
Input Leakage Current	I_{IN}	$V_{IN} = V_{CC}$ or GND	5.5	—	—	± 0.1	—	± 1.0	μA	
Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC}$ or GND	5.5	—	—	4.0	—	40.0		

* This spec indicates the capability of driving 50Ω transmission lines.
One output should be tested at a time for a 10ms maximum duration.

System Diagram



Timing Requirements (Input $t_r=t_f=3ns$)

PARAMETER	SYMBOL	TEST CONDITION	Ta = 25°C		Ta =	UNIT
			Vcc	Typ.	Max.	
Minimum Pulse Width (CK)	$t_{W(L)}$ $t_{W(H)}$	—	3.3 ± 0.3	—	8.0	ns
			5.0 ± 0.5	—	5.0	
Minimum Pulse Width (CLR, PR)	$t_{W(L)}$	—	3.3 ± 0.3	—	7.0	
			5.0 ± 0.5	—	5.0	
Minimum Set-up Time	t_s	—	3.3 ± 0.3	—	9.0	
			5.0 ± 0.5	—	5.0	
Minimum Hold Time	t_h	—	3.3 ± 0.3	—	0.0	
			5.0 ± 0.5	—	0.0	
Minimum Removal Time (CLR, PR)	t_{rem}	—	3.3 ± 0.3	—	3.0	
			5.0 ± 0.5	—	2.0	

AC Electrical Characteristics ($C_L = 50\text{pF}$, $R_L = 500\Omega$, Input $t_r = t_f = 3\text{ns}$)

PARAMETER	SYMBOL	TEST CONDITION	Ta = 25°C			Ta = -40-85°C		UNIT	
			V _{CC}	Min.	Typ.	Max.	Min.		Max.
Propagation Delay Time (CK-Q, Q)	t_{pLH} t_{pHL}	—	3.3±0.3	—	8.2	13.9	1.0	16.5	ns
			5.0±0.5	—	6.1	8.7	1.0	10.0	
Propagation Delay Time (CLR, PR-Q, Q)	t_{pLH} t_{pHL}	—	3.3±0.3	—	8.5	14.4	1.0	16.6	
			5.0±0.5	—	6.4	9.1	1.0	10.5	
Maximum Clock Frequency	f_{MAX}	—	3.3±0.3	55	120	—	55	—	MHz
			5.0±0.5	100	160	—	100	—	
Input Capacitance	C_{IN}	—	—	—	5	10	—	10	pF
Power Dissipation Capacitance	C_{PD}^1	—	—	—	82	—	—	—	

Note (1): C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.
Average operating current can be obtained by the equation: $I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 2$ (per F/F).