

# SN54HC109, SN74HC109 DUAL J-K POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH CLEAR AND PRESET

D2684, DECEMBER 1982—REVISED JUNE 1989

- Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers, and Standard Plastic and Ceramic 300-mil DIPs
- Dependable Texas Instruments Quality and Reliability

## description

These devices contain two independent J-K negative-edge-triggered flip-flops. A low level at the Preset or clear inputs sets or resets the outputs regardless of the levels of the other inputs. When Preset and Clear are inactive (high), data at the J and K inputs meeting the setup time requirements are transferred to the outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a voltage level and is not directly related to the rise time of the clock pulse. Following the hold time interval, data at the J and K inputs may be changed without affecting the levels at the outputs. These versatile flip-flops can perform as toggle flip-flops by grounding K and tying J high. They also can perform as D-type flip-flops if J and K are tied together.

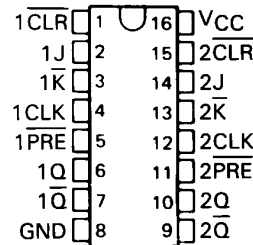
The SN54HC109 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74HC109 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

FUNCTION TABLE

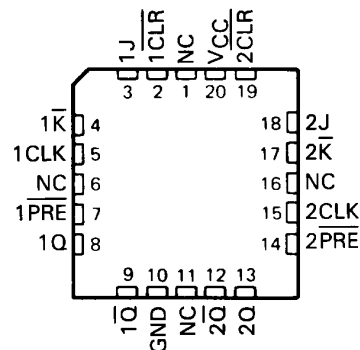
INPUTS					OUTPUTS	
PRE	CLR	CLK	J	K	Q	$\bar{Q}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H <sup>‡</sup>	H <sup>‡</sup>
H	H	↑	L	L	L	H
H	H	↑	H	L	TOGGLE	
H	H	↑	L	H	Q <sub>0</sub>	$\bar{Q}_0$
H	H	↑	H	H	H	L
H	H	L	X	X	Q <sub>0</sub>	$\bar{Q}_0$

<sup>‡</sup>This configuration is nonstable; that is, it will not persist when Preset or Clear return to their inactive (high) level.

SN54HC109 . . . J PACKAGE  
SN74HC109 . . . D OR N PACKAGE  
(TOP VIEW)

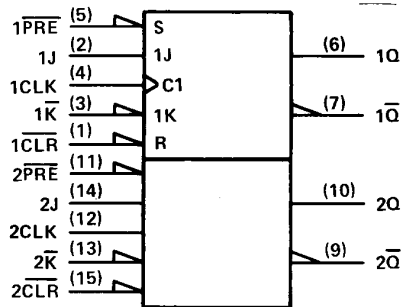


SN54HC109 . . . FK PACKAGE  
(TOP VIEW)



NC—No internal connection

## logic symbol†



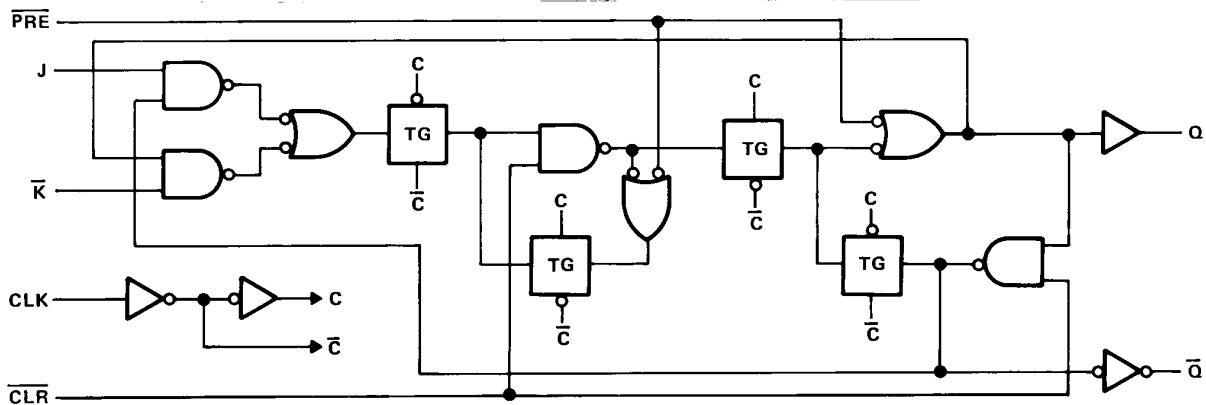
<sup>†</sup>This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for D, J, and N packages.

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logic diagram, each flip-flop (positive logic)



absolute maximum ratings over operating free-air temperature range†

Supply voltage, $V_{CC}$ .....	-0.5 V to 7 V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) .....	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) .....	$\pm 20$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....	$\pm 25$ mA
Continuous current through $V_{CC}$ or GND pins .....	$\pm 50$ mA
Lead temperature 1,6 mm (1/16 in) from case for 60 s: FK or J package .....	300°C
Lead temperature 1,6 mm (1/16 in) from case for 10 s: D or N package .....	260°C
Storage temperature range .....	-65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

recommended operating conditions

		SN54HC109			SN74HC109			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	2	5	6	2	5	6	V
$V_{IH}$	High-level input voltage	$V_{CC} = 2$ V	1.5		1.5			V
		$V_{CC} = 4.5$ V	3.15		3.15			
		$V_{CC} = 6$ V	4.2		4.2			
$V_{IL}$	Low-level input voltage	$V_{CC} = 2$ V	0	0.3	0	0.3	V	
		$V_{CC} = 4.5$ V	0	0.9	0	0.9		
		$V_{CC} = 6$ V	0	1.2	0	1.2		
$V_I$	Input voltage	0		$V_{CC}$	0		$V_{CC}$	V
$V_O$	Output voltage	0		$V_{CC}$	0		$V_{CC}$	V
$t_t$	Input transition (rise and fall) times	$V_{CC} = 2$ V	0	1000	0	1000	ns	
		$V_{CC} = 4.5$ V	0	500	0	500		
		$V_{CC} = 6$ V	0	400	0	400		
$T_A$	Operating free-air temperature	-55		125	-40		85	°C

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C			SN54HC109		SN74HC109		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V <sub>OH</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> , I <sub>OH</sub> = -20 μA	2 V	1.9	1.998		1.9		1.9	V	
		4.5 V	4.4	4.499		4.4		4.4		
		6 V	5.9	5.999		5.9		5.9		
V <sub>OL</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> , I <sub>OL</sub> = 20 μA	4.5 V	3.98	4.30		3.7		3.84	V	
		6 V	5.48	5.80		5.2		5.34		
		2 V			0.002	0.1				0.1
V <sub>OL</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> , I <sub>OL</sub> = 4 mA	4.5 V			0.001	0.1			0.1	
		6 V			0.001	0.1			0.1	
		2 V			0.17	0.26			0.4	
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or 0	4.5 V			0.15	0.26			0.4	
		6 V							0.33	
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0	6 V			±0.1	±100			±1000	nA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0	6 V							4	μA
C <sub>I</sub>		2 to 6 V							10	pF

timing requirements over recommended operating free-air temperature range (unless otherwise noted)

		V <sub>CC</sub>	T <sub>A</sub> = 25°C			SN54HC109		SN74HC109		UNIT
			MIN		MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency	2 V	0		6	0	4.2	0	5	MHz
		4.5 V	0		31	0	21	0	25	
		6 V	0		36	0	25	0	29	
t <sub>w</sub>	Pulse duration	PRE or CLR low	2 V	100			150		125	ns
			4.5 V	20			30		25	
			6 V	17			25		21	
	CLK high or low	2 V	80			120		100		
		4.5 V	16			24		20		
		6 V	14			20		17		
t <sub>su</sub>	Setup time before CLK↑	Data (J, K)	2 V	100			150		125	
			4.5 V	20			30		25	
			6 V	17			25		21	
	PRE or CLR inactive	2 V	25			40		30		
		4.5 V	5			8		6		
		6 V	4			7		5		
t <sub>h</sub>	Hold time, data after CLK↑	2 V	0			0		0	ns	
		4.5 V	0			0		0		
		6 V	0			0		0		

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switching characteristics over recommended operating free-air temperature range (unless otherwise noted),  $C_L = 50 \text{ pF}$  (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HC109		SN74HC109		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{\text{max}}$			2 V	6	10		4.2		5	MHz	
			4.5 V	31	50		21		25		
			6 V	36	60		25		29		
$t_{\text{pd}}$	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$	Q or $\overline{Q}$	2 V		60	230		345		290	ns
			4.5 V		15	46		69		58	
			6 V		12	39		59		49	
$t_{\text{pd}}$	CLK	Q or $\overline{Q}$	2 V		50	175		250		220	ns
			4.5 V		15	35		50		44	
			6 V		12	30		42		37	
$t_t$		Q or $\overline{Q}$	2 V		28	75		110		95	ns
			4.5 V		8	15		22		19	
			6 V		6	13		19		16	

$C_{\text{pd}}$	Power dissipation capacitance per flip-flop	No load, $T_A = 25^\circ\text{C}$	35 pF typ
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NOTE 1: Load circuit and voltage waveforms are shown in Section 1.

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