- **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-$\overline{K}$ 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 $\overline{K}$ 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 $\overline{K}$ inputs may be changed without affecting the levels at the outputs. These versatile flip-flops can perform as toggle flip-flops by grounding $\overline{K}$ and tying J high. They also can perform as D-type flip-flops if J and $\overline{K}$ are tied together.

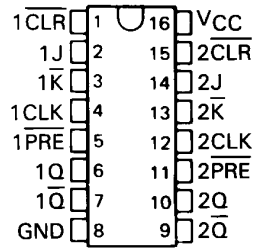
The SN54HC109 is characterized for operation over the full military temperature range of −55°C to 125°C. The SN74HC109 is characterized for operation from −40°C to 85°C.

FUNCTION TABLE

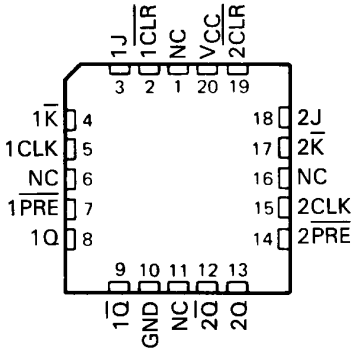
INPUTS					OUTPUTS	
$\overline{PRE}$	$\overline{CLR}$	CLK	J	$\overline{K}$	Q	$\overline{Q}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H‡	H‡
H	H	↑	L	L	L	H
H	H	↑	H	L	TOGGLE	
H	H	↑	L	H	Q_0	$\overline{Q}_0$
H	H	↑	H	H	H	L
H	H	L	X	X	Q_0	$\overline{Q}_0$

‡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)

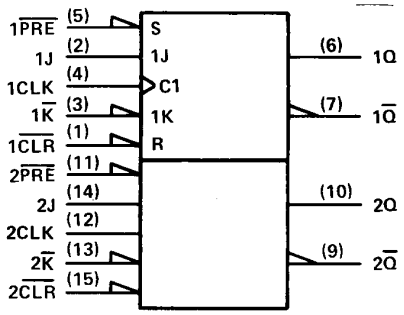


SN54HC109 . . . FK PACKAGE
(TOP VIEW)



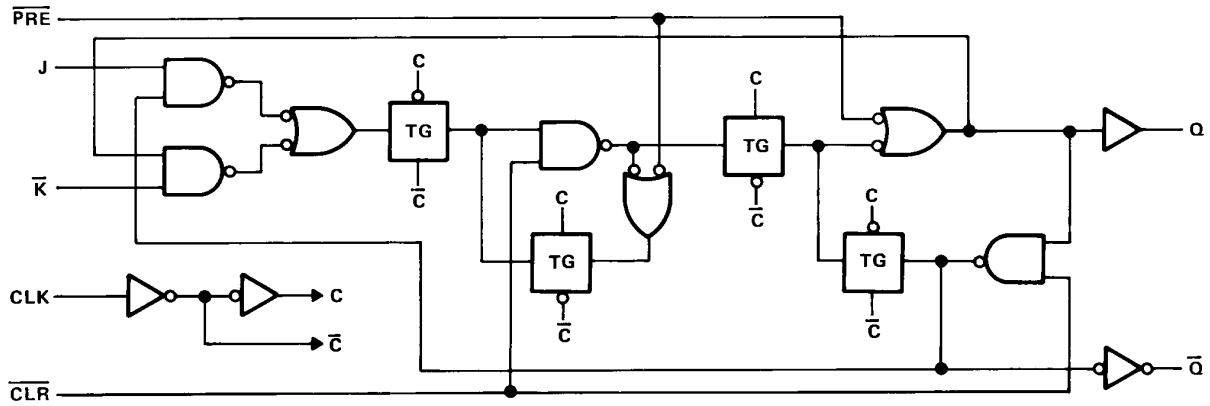
NC—No internal connection

logic symbol†



†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.

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 $V_I > V_{CC}$)	±20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$	±20 mA
Continuous output current, I_O (V_O = 0 to V_{CC})	±25 mA
Continuous current through V_{CC} or GND pins	±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

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

PARAMETER	TEST CONDITIONS	V_{CC}	T_A = 25°C			SN54HC109		SN74HC109		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{OH}	V_I = V_{IH} or V_{IL}, I_{OH} = −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_I = V_{IH} or V_{IL}, I_{OH} = −4 mA	4.5 V	3.98	4.30		3.7		3.84		
	V_I = V_{IH} or V_{IL}, I_{OH} = −5.2 mA	6 V	5.48	5.80		5.2		5.34		
V_{OL}	V_I = V_{IH} or V_{IL}, I_{OL} = 20 μA	2 V		0.002	0.1		0.1		0.1	V
		4.5 V		0.001	0.1		0.1		0.1	
		6 V		0.001	0.1		0.1		0.1	
	V_I = V_{IH} or V_{IL}, I_{OL} = 4 mA	4.5 V		0.17	0.26		0.4		0.33	
	V_I = V_{IH} or V_{IL}, I_{OL} = 5.2 mA	6 V		0.15	0.26		0.4		0.33	
I_I	V_I = V_{CC} or 0	6 V		±0.1	±100		±1000		±1000	nA
I_{CC}	V_I = V_{CC} or 0, I_O = 0	6 V			4		80		40	μA
C_I		2 to 6 V		3	10		10		10	pF

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

			V_{CC}	T_A = 25°C		SN54HC109		SN74HC109		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	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_w	Pulse duration	$\overline{PRE}$ or $\overline{CLR}$ 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_{su}	Setup time before CLK↑	Data (J, K)	2 V	100		150		125		ns
			4.5 V	20		30		25		
			6 V	17		25		21		
		$\overline{PRE}$ or $\overline{CLR}$ inactive	2 V	25		40		30		
			4.5 V	5		8		6		
			6 V	4		7		5		
t_h	Hold time, data after CLK↑		2 V	0		0		0		ns
			4.5 V	0		0		0		
			6 V	0		0		0		

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			SN54HC109		SN74HC109		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			2 V	6	10		4.2		5		MHz
			4.5 V	31	50		21		25		
			6 V	36	60		25		29		
t_{pd}	$\overline{PRE}$ or $\overline{CLR}$	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_{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_{pd}	Power dissipation capacitance per flip-flop	No load, T_A = 25°C	35 pF typ

NOTE 1: Load circuit and voltage waveforms are shown in Section 1.

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POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

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