

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

DECEMBER 1983 — REVISED MARCH 1988

**SN54109, SN54LS109A,  
SN74109, SN74LS109A**

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

SN54109, SN54LS109A . . . J OR W PACKAGE  
SN74109 . . . N PACKAGE  
SN74LS109A . . . D OR N PACKAGE  
(TOP VIEW)



SN54LS109A . . . FK PACKAGE  
(TOP VIEW)



### description

These devices contain two independent J-K positive-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.

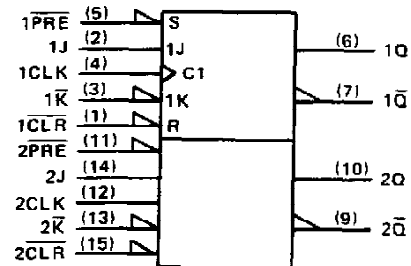
The SN54109 and SN54LS109A are characterized for operation over the full military temperature range of -55°C to 125°C. The SN74109 and SN74LS109A are characterized for operation from 0°C to 70°C.

FUNCTION TABLE (each flip-flop)

INPUTS					OUTPUTS	
PRE	CLR	CLK	J	K	Q	Q̄
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	TOGGLE
H	H	↑	L	H	Q <sub>0</sub>	Q̄ <sub>0</sub>
H	H	↑	H	H	H	L
H	H	L	X	X	Q <sub>0</sub>	Q̄ <sub>0</sub>

† The output levels in this configuration are not guaranteed to meet the minimum levels for V<sub>OH</sub> if the lows at preset and clear are near V<sub>IL</sub> maximum. Furthermore, this configuration is nonstable; that is, it will not persist when preset or clear return to their inactive (high) level.

### 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, N, and W packages.

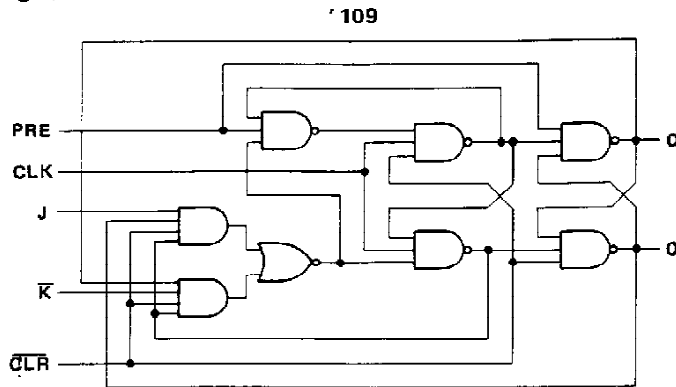
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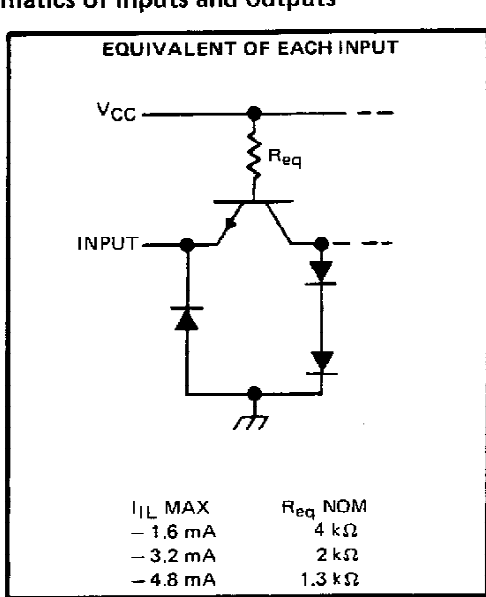
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**SN54109, SN74109**  
**DUAL J-K POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESET AND CLEAR**

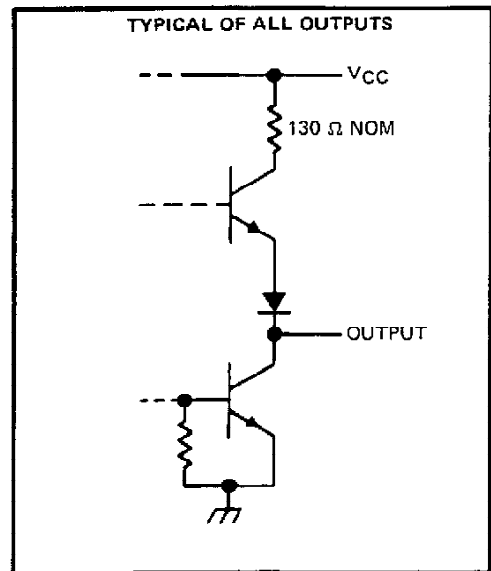
logic diagram (positive logic)



schematics of inputs and outputs



'109



**SN54109, SN54LS109A,  
SN74109, SN74LS109A**

**DUAL J-K POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESET AND CLEAR**

schematic



**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)**

Supply voltage, $V_{CC}$ (see Note 1) .....	7 V
Input voltage: '109 .....	5.5 V
'LS109A .....	7 V
Operating free-air temperature range: SN54' .....	-55°C to 125°C
SN74' .....	0°C to 70°C
Storage temperature range .....	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

**TEXAS  
INSTRUMENTS**

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# SN54109, SN74109

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

### recommended operating conditions

	SN54109			SN74109			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub> Supply voltage	4.5	5	5.5	4.75	5	5.25	V
V <sub>IH</sub> High-level input voltage	2			2			V
V <sub>IL</sub> Low-level input voltage			0.8			0.8	V
I <sub>OH</sub> High-level output current			-0.8			-0.8	mA
I <sub>OL</sub> Low-level output current			16			16	mA
t <sub>w</sub> Pulse duration	CLK high or low		20	20			ns
	PRE or CLR low		20	20			
t <sub>su</sub> Input setup time before CLK †	10			10			ns
t <sub>h</sub> Input hold time-data after CLK †	6			6			ns
T <sub>A</sub> Operating free-air temperature	-55		125	0		70	°C

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

PARAMETER	TEST CONDITIONS†	SN54109		SN74109		UNIT	
		MIN	TYP‡	MAX	MIN		TYP‡
V <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = -12 mA			-1.5		-1.5	V
V <sub>OH</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = -0.8 mA	2.4	3.4	2.4	3.4		V
V <sub>OL</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V, I <sub>OL</sub> = 16 mA		0.2	0.4	0.2	0.4	V
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V		1		1		mA
I <sub>IH</sub>	J or K		40		40		μA
	CLR		160		160		
	PRE or CLK	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.4 V		80		80	
I <sub>IL</sub>	J or K		-1.6		-1.6		mA
	CLR †		-4.8		-4.8		
	PRE †		-3.2		-3.2		
	CLK	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V		-3.2		-3.2	
I <sub>OS</sub> §	V <sub>CC</sub> = MAX	-30		-85	-30		mA
I <sub>CC</sub> #	V <sub>CC</sub> = MAX, See Note 2		9	15	9	15	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

§ Not more than one output should be shorted at a time.

† Clear is tested with preset high and preset is tested with clear high.

# Average per flip-flop.

NOTE 2: With all outputs open, I<sub>CC</sub> is measured with the Q and Q̄ outputs high in turn. At the time of measurement, the clock input is grounded.

### switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see note 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f <sub>max</sub>				25	33		MHz
t <sub>PLH</sub>	PRE	Q	R <sub>L</sub> = 400 Ω, C <sub>L</sub> = 15 pF		10	15	ns
t <sub>PHL</sub>		Q̄			23	35	ns
t <sub>PLH</sub>	CLR	Q̄			10	15	ns
t <sub>PHL</sub>		Q			17	25	ns
t <sub>PLH</sub>	CLK	Q or Q̄			10	16	ns
t <sub>PHL</sub>						18	28

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



# SN54LS109A, SN74LS109A DUAL J-K POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESET AND CLEAR

## recommended operating conditions

		SN54LS109A			SN74LS109A			UNIT
		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
$f_{clock}$	Clock frequency	0		25	0		25	MHz
$t_w$	Pulse duration	CLK high		25			25	ns
		PRE or CLR low		25			25	
$t_{su}$	Setup time before CLK †	High-level data		35			35	ns
		Low-level data		25			25	
$t_h$	Hold time-data after CLK †			5			5	ns
$T_A$	Operating free-air temperature	-55		125	0		70	°C

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

PARAMETER	TEST CONDITIONS†	SN54LS109A		SN74LS109A		UNIT		
		MIN	TYP‡	MAX	MIN		TYP‡	MAX
$V_{IK}$	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$			-1.5		-1.5	V	
$V_{OH}$	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = \text{MAX}, I_{OH} = -0.4 \text{ mA}$	2.5	3.4		2.7	3.4	V	
$V_{OL}$	$V_{CC} = \text{MIN}, I_{OL} = 4 \text{ mA}, V_{IL} = \text{MAX}, V_{IH} = 2 \text{ V}$		0.25	0.4		0.25	0.4	V
	$V_{CC} = \text{MIN}, I_{OL} = 8 \text{ mA}, V_{IL} = \text{MAX}, V_{IH} = 2 \text{ V}$					0.35	0.5	
$I_I$	J, K or CLK			0.1		0.1	mA	
	CLR or PRE			0.2		0.2		
$I_{IH}$	J, K or CLK			20		20	$\mu\text{A}$	
	CLR or PRE			40		40		
$I_{IL}$	J, K or CLK			-0.4		-0.4	mA	
	CLR or PRE			-0.8		-0.8		
$I_{OS}\S$	$V_{CC} = \text{MAX},$ See Note 4	-20		-100	-20		-100	mA
$I_{CC}$ (Total)	$V_{CC} = \text{MAX},$ See Note 2		4	8		4	8	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

§ Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second.

NOTE 2: With all outputs open,  $I_{CC}$  is measured with the Q and  $\bar{Q}$  outputs high in turn. At the time of measurement, the clock input is grounded.

NOTE 4: For certain devices where state commutation can be caused by shorting an output to ground, an equivalent test may be performed with  $V_O = 2.25 \text{ V}$  and  $2.125 \text{ V}$  for the 54 family and the 74 family, respectively with the minimum and maximum limits reduced to one half of their stated values.

## switching characteristics, $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ (see note 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$f_{max}$				25	33		MHz
$t_{PLH}$	CLR, PRE	Q or $\bar{Q}$	$R_L = 2 \text{ k}\Omega, C_L = 15 \text{ pF}$		13	25	ns
$t_{PHL}$	or CLK				25	40	ns

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

  
**TEXAS  
INSTRUMENTS**

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**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
JM38510/30109B2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
JM38510/30109BEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
JM38510/30109BEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
JM38510/30109BFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type
JM38510/30109BFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type
JM38510/30109SEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
JM38510/30109SEA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
JM38510/30109SFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type
JM38510/30109SFA	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type
SN54LS109AJ	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
SN54LS109AJ	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
SN74109N	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74109N	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74LS109AD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109AD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ADE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ADE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ADG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ADG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ADR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ADR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ADRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ADRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ADRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ADRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS109AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS109AN3	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74LS109AN3	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74LS109ANE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS109ANE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN74LS109ANSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ANSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ANSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ANSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ANSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS109ANSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54LS109AFK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ54LS109AFK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ54LS109AJ	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
SNJ54LS109AJ	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
SNJ54LS109AW	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type
SNJ54LS109AW	ACTIVE	CFP	W	16	1	TBD	A42	N / A for Pkg Type

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

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**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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**TAPE AND REEL INFORMATION**



**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74LS109ADR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN74LS109ANSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1



**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74LS109ADR	SOIC	D	16	2500	333.2	345.9	28.6
SN74LS109ANSR	SO	NS	16	2000	346.0	346.0	33.0

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