SDLS037

DUAL J-$\overline{K}$ POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESET AND CLEAR

DECEMBER 1983 – REVISED MARCH 1988

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

description

These devices contain two independent J-$\overline{K}$ 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 $\overline{K}$ 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.

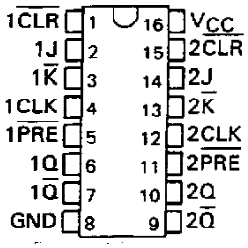
The SN54109 and SN54LS109A are characterized for operation over the full military temperature range of −55°C to 125°C. The SN74109 and SN74LS109A are characterized for operation from 0°C to 70°C.

FUNCTION TABLE (each flip-flop)

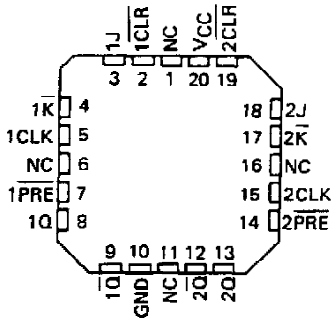
INPUTS					OUTPUTS	
$\overline{PRE}$	$\overline{CLR}$	CLK	J	K	Q	$\overline{Q}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H†	H†
H	H	↑	L	L	L	H
H	H	↑	H	L	TOGGLE	
H	H	↑	L	H	Q_0	$\overline{Q}_0$
H	H	↑	H	H	H	L
H	H	L	X	X	Q_0	$\overline{Q}_0$

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

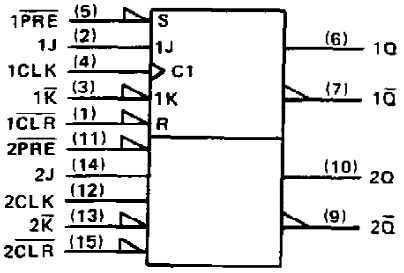
SN54109, SN54LS109A . . . J OR W PACKAGE
SN74109 . . . N PACKAGE
SN74LS109A . . . D OR N PACKAGE
(TOP VIEW)



SN54LS109A . . . FK PACKAGE
(TOP VIEW)



logic symbol‡



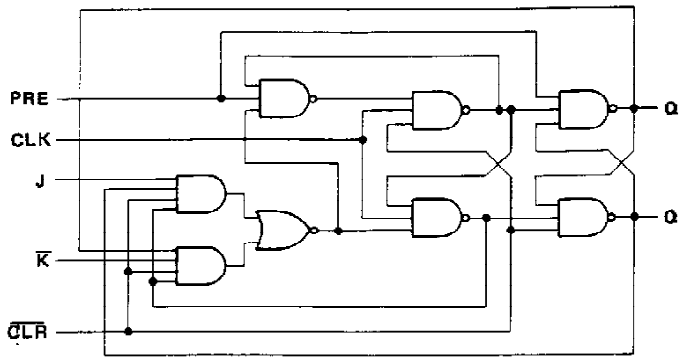
‡This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Pin numbers shown are for D, J, N, and W packages.

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

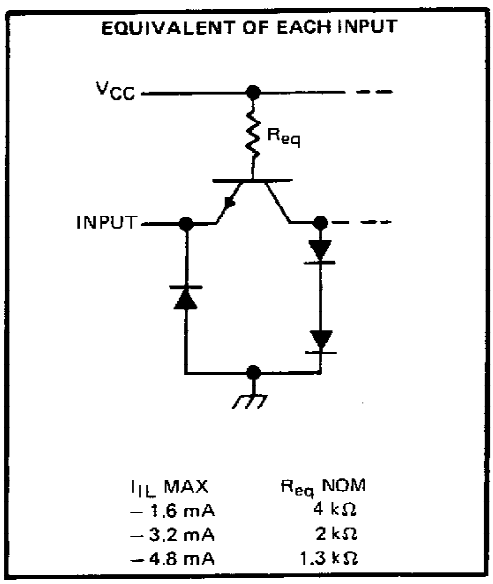
logic diagram (positive logic)

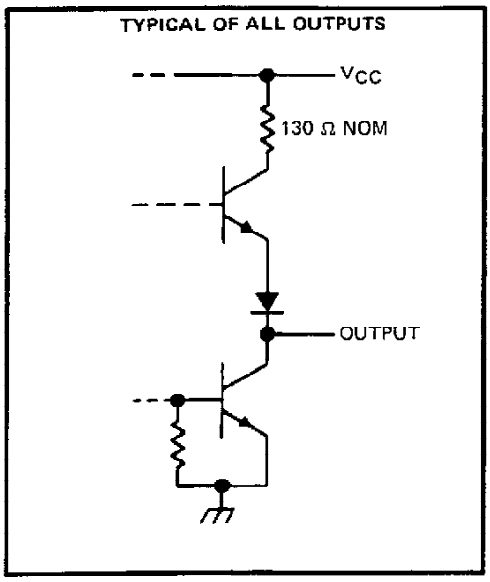
'109



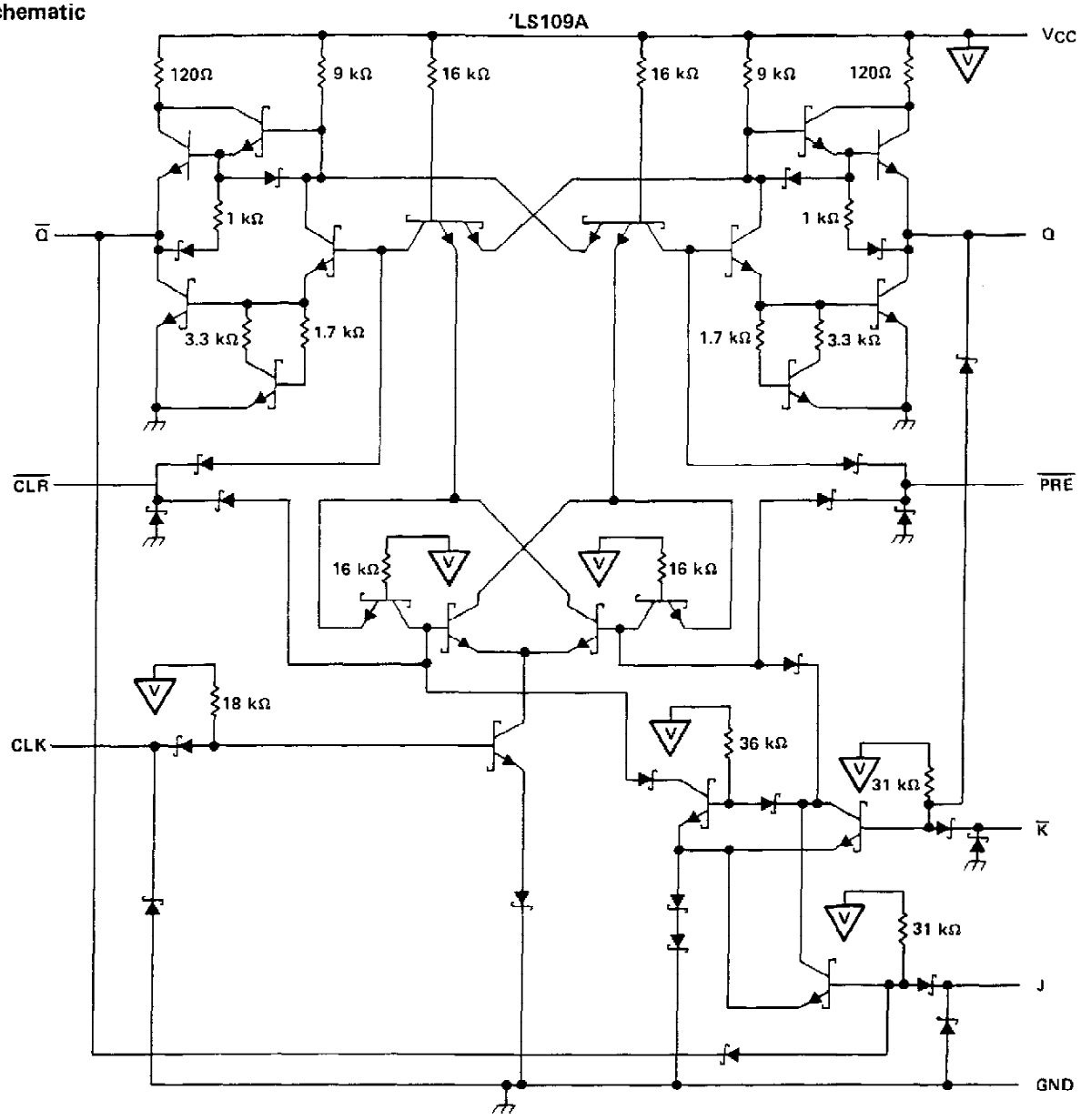
schematics of inputs and outputs

'109





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.

recommended operating conditions

			SN54109			SN74109			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				0.8			0.8	V
I_{OH}	High-level output current				−0.8			−0.8	mA
I_{OL}	Low-level output current				16			16	mA
t_w	Pulse duration	CLK high or low	20			20			ns
		$\overline{PRE}$ or $\overline{CLR}$ low	20			20			
t_{su}	Input setup time before CLK↑		10			10			ns
t_h	Input hold time-data after CLK↑		6			6			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†			SN54109			SN74109			UNIT
					MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IK}		V_{CC} = MIN,	I_I = −12 mA				−1.5			−1.5	V
V_{OH}		V_{CC} = MIN, I_{OH} = −0.8 mA	V_{IH} = 2 V,	V_{IL} = 0.8 V,	2.4	3.4		2.4	3.4		V
V_{OL}		V_{CC} = MIN, I_{OL} = 16 mA	V_{IH} = 2 V,	V_{IL} = 0.8 V,		0.2	0.4		0.2	0.4	V
I_I		V_{CC} = MAX,	V_I = 5.5 V				1			1	mA
I_{IH}	J or $\overline{K}$	V_{CC} = MAX,	V_I = 2.4 V				40			40	μA
	$\overline{CLR}$						160			160	
	$\overline{PRE}$ or CLK						80			80	
I_{IL}	J or $\overline{K}$	V_{CC} = MAX,	V_I = 0.4 V				−1.6			−1.6	mA
	$\overline{CLR}$¶						−4.8			−4.8	
	$\overline{PRE}$¶						−3.2			−3.2	
	CLK						−3.2			−3.2	
I_{OS}§		V_{CC} = MAX			−30		−85	−30		−85	mA
I_{CC}#		V_{CC} = 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_{CC} = 5 V, T_A = 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_{CC} is measured with the Q and $\overline{Q}$ outputs high in turn. At the time of measurement, the clock input is grounded.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see note 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}			R_L = 400 Ω, C_L = 15 pF	25	33		MHz
t_{PLH}	$\overline{PRE}$	Q			10	15	ns
t_{PHL}		$\overline{Q}$			23	35	ns
t_{PLH}	$\overline{CLR}$	$\overline{Q}$			10	15	ns
t_{PHL}		Q			17	25	ns
t_{PLH}	CLK	Q or $\overline{Q}$			10	16	ns
t_{PHL}					18	28	ns

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

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
		$\overline{PRE}$ or $\overline{CLR}$ 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} = MIN,	I_I = −18 mA				−1.5			−1.5	V
V_{OH}		V_{CC} = MIN, I_{OH} = −0.4 mA	V_{IH} = 2 V,	V_{IL} = MAX,	2.5	3.4		2.7	3.4		V
V_{OL}		V_{CC} = MIN, I_{OL} = 4 mA	V_{IL} = MAX,	V_{IH} = 2 V,		0.25	0.4		0.25	0.4	V
		V_{CC} = MIN, I_{OL} = 8 mA	V_{IL} = MAX,	V_{IH} = 2 V,					0.35	0.5	
I_I	J, $\overline{K}$ or CLK	V_{CC} = MAX,	V_I = 7 V				0.1			0.1	mA
	$\overline{CLR}$ or $\overline{PRE}$						0.2			0.2	
I_{IH}	J, $\overline{K}$ or CLK	V_{CC} = MAX,	V_I = 2.7 V				20			20	μA
	$\overline{CLR}$ or $\overline{PRE}$						40			40	
I_{IL}	J, $\overline{K}$ or CLK	V_{CC} = MAX,	V_I = 0.4 V				−0.4			−0.4	mA
	$\overline{CLR}$ or $\overline{PRE}$						−0.8			−0.8	
I_{OS}§		V_{CC} = MAX,	See Note 4		−20		−100	−20		−100	mA
I_{CC} (Total)		V_{CC} = 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 V, T_A = 25°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 $\overline{Q}$ 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 V and 2.125 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 V, T_A = 25°C (see note 3)

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

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

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PRODUCT FOLDER | PRODUCT INFO: FEATURES | DESCRIPTION | DATASHEETS | PRICING/AVAILABILITY/PKG | APPLICATION NOTES | RELATED DOCUMENTS

PRODUCT SUPPORT: TRAINING

SN74LS109A, Dual J-K Positive-Edge-Triggered Flip-Flops With Clear And Preset

DEVICE STATUS: **ACTIVE**

PARAMETER NAME	SN54LS109A	SN74LS109A
Voltage Nodes (V)	5	5
Vcc range (V)	4.5 to 5.5	4.75 to 5.25
Input Level	TTL	TTL
Output Level	TTL	TTL
Output Drive (mA)		-0.4/8
Output	2S	2S
No. of Bits	2	2
th (ns)		5
tpd max (ns)		40
tsu (ns)		9.4

FEATURES

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

DESCRIPTION

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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.

TECHNICAL DOCUMENTS

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To view the following documents, Acrobat Reader 4.0 is required.

To download a document to your hard drive, right-click on the link and choose 'Save'.

DATASHEET

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Full datasheet in Acrobat PDF: sn74ls109a.pdf (271 KB) (Updated: 03/01/1988)

APPLICATION NOTES

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View Application Notes for Digital Logic

- Designing With Logic (Rev. C) (SDYA009C - Updated: 06/01/1997)
- Designing with the SN54/74LS123 (Rev. A) (SDLA006A - Updated: 03/01/1997)
- Evaluation of Nickel/Palladium/Gold-Finished Surface-Mount Integrated Circuits (SZZA026 - Updated: 06/20/2001)
- Input and Output Characteristics of Digital Integrated Circuits (SDYA010 - Updated: 10/01/1996)
- Live Insertion (SDYA012 - Updated: 10/01/1996)

RELATED DOCUMENTS Back to Top

View Related Documentation for Digital Logic

- Logic Reference Guide (SCYB004, 1032 KB - Updated: 10/23/2001)
- Logic Selection Guide Second Half 2002 (Rev. R) (SDYU001R, 4274 KB - Updated: 07/19/2002)
- Military Semiconductors Selection Guide 2002 (Rev. B) (SGYC003B, 1648 KB - Updated: 04/22/2002)

PRICING/AVAILABILITY/PKG Back to Top

DEVICE INFORMATION							TI INVENTORY STATUS AS OF 3:00 PM GMT, 26 Sep 2002			REPORTED DISTRIBUTOR INVENTORY AS OF 3:00 PM GMT, 26 Sep 2002		
ORDERABLE DEVICE	STATUS	PACKAGE TYPE|PINS	TEMP (°C)	PRODUCT CONTENT	BUDGETARY PRICING QTY | $US	STD PACK QTY	IN STOCK	IN PROGRESS QTY|DATE	LEAD TIME	DISTRIBUTOR COMPANY|REGION	IN STOCK	PURCHASE
SN74LS109AD	ACTIVE	SOP (D) | 16	0 TO 70	View Contents	1KU | 0.42	40	N/A*	1114 | 03 Oct	4 WKS			
								>10k | 10 Oct				
								>10k | 17 Oct				
								>10k | 24 Oct				
SN74LS109ADR	ACTIVE	SOP (D) | 16	0 TO 70	View Contents	1KU | 0.45	2500	N/A*	1114 | 03 Oct	4 WKS			
								>10k | 10 Oct				
								>10k | 17 Oct				
								>10k | 24 Oct				
SN74LS109AN	ACTIVE	PDIP (N) | 16	0 TO 70	View Contents	1KU | 0.42	25	N/A*	>10k | 02 Oct	4 WKS	Avnet | AMERICA	>1k	BUY NOW
								1616 | 07 Oct				
								>10k | 09 Oct				
								>10k | 16 Oct				
								>10k | 23 Oct				
SN74LS109AN3	OBSOLETE	PDIP (N) | 16	0 TO 70	View Contents	1KU |		N/A*		Not Available			
SN74LS109ANSR	ACTIVE	SOP (NS) | 16		View Contents	1KU | 0.42	2000	N/A*	1608 | 04 Oct	4 WKS			

								2302 | 11 Oct						
								>10k | 18 Oct						

Table Data Updated on: 9/26/2002

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