

SN54LS112A, SN54S112, SN74LS112A, SN74S112A DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESET AND CLEAR

D2661, APRIL 1982—REVISED MARCH 1988

SDLS011

- Fully Buffered to Offer Maximum Isolation from External Disturbance
- 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-K negative-edge-triggered flip-flops. A low level at the preset and 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 negative-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 tying J and K high.

The SN54LS112A and SN54S112 are characterized for operation over the full military temperature range of -55°C to 125°C . The SN74LS112A and SN74S112A are characterized for operation from 0°C to 70°C .

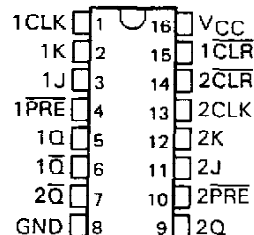
FUNCTION TABLE (each flip-flop)

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 [†]	H [†]
H	H	↓	L	L	Q ₀	\bar{Q}_0
H	H	↓	H	L	H	L
H	H	↓	L	H	L	H
H	H	↓	H	H	TOGGLE	
H	H	H	X	X	Q ₀	\bar{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} minimum. Furthermore, this configuration is nonstable; that is, it will not persist when either preset or clear returns to its inactive (high) level.

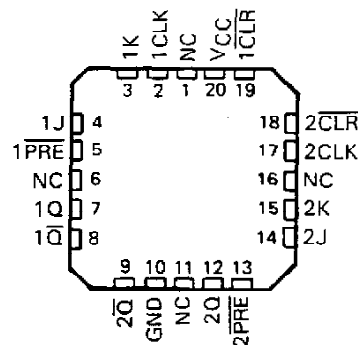
SN54LS112A, SN54S112 . . . J OR W PACKAGE
SN74LS112A, SN74S112A . . . D OR N PACKAGE

(TOP VIEW)



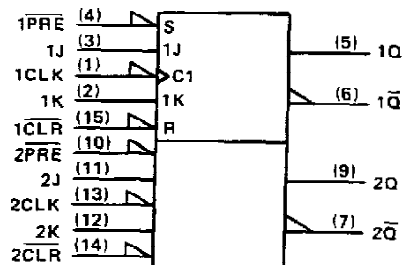
SN54LS112A, SN54S112 . . . FK PACKAGE

(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, 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.

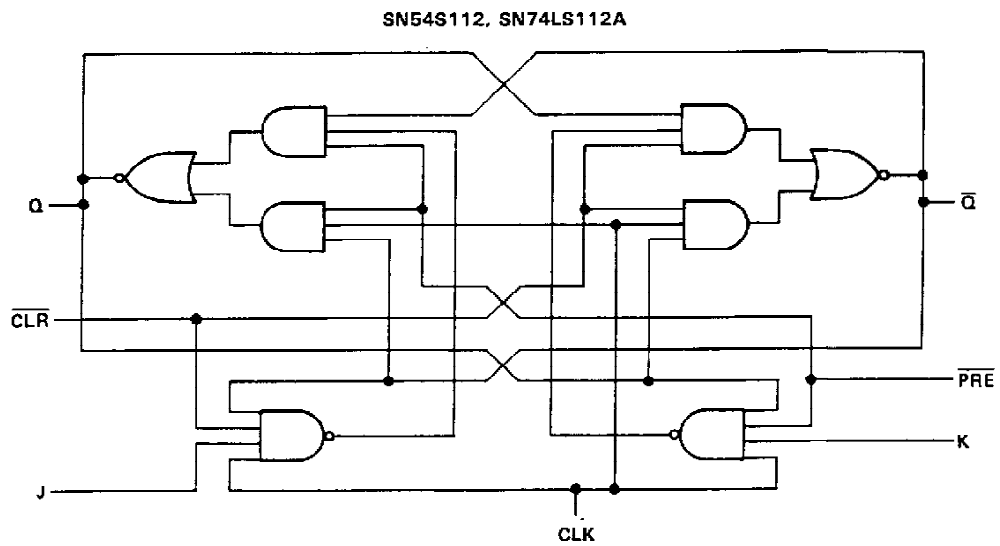
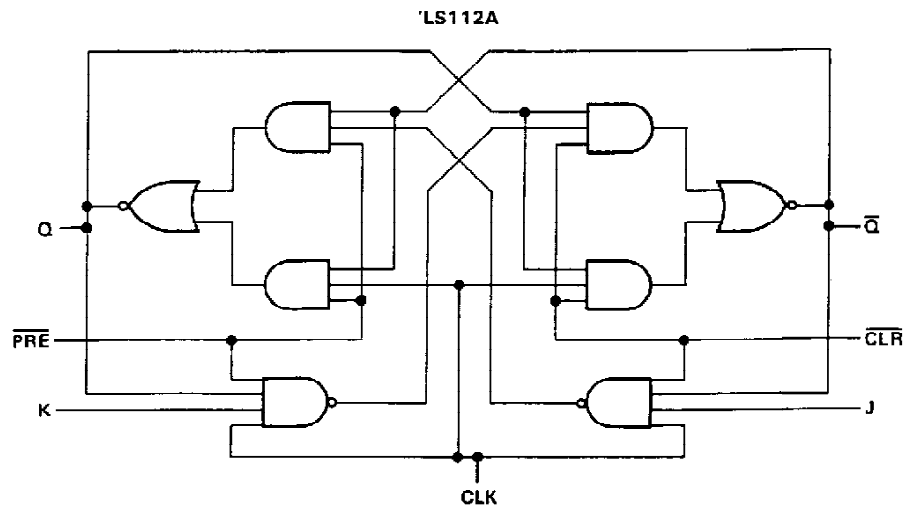
TEXAS
INSTRUMENTS

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

Copyright © 1982, Texas Instruments Incorporated

SN54LS112A, SN54S112, SN74LS112A, SN74S112A DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESET AND CLEAR

logic diagrams (positive logic)



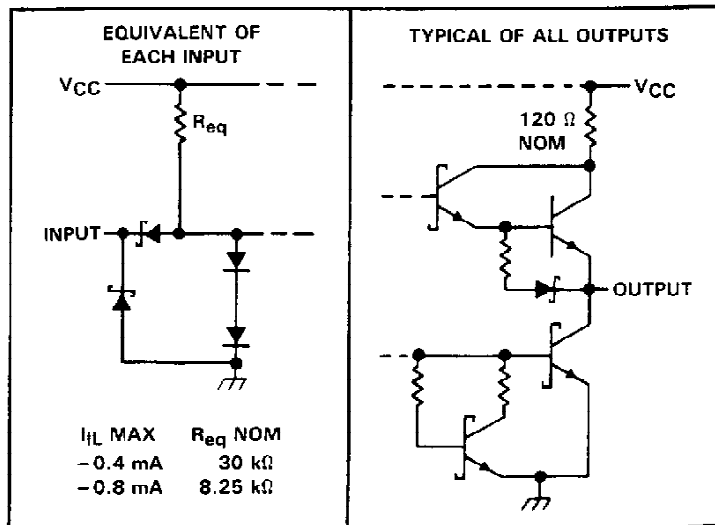
TEXAS
INSTRUMENTS

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

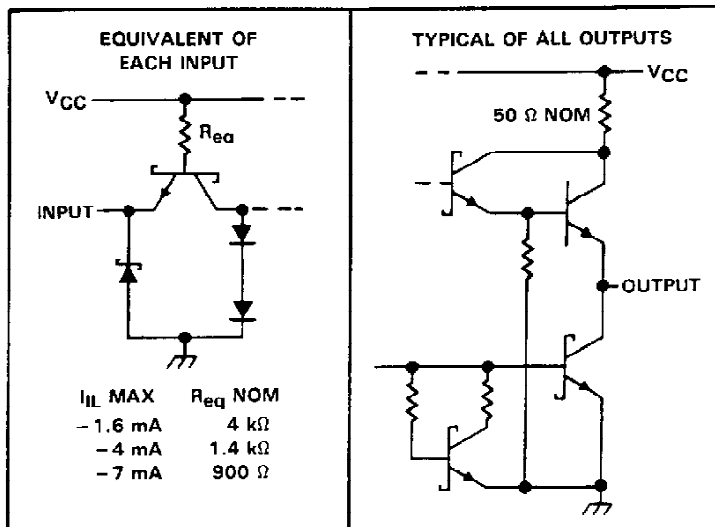
SN54LS112A, SN54S112, SN74LS112A, SN74S112A
DUAL J-K NEGATIVE-EDGE-TRIGGERED
FLIP-FLOPS WITH PRESET AND CLEAR

schematics of inputs and outputs

'LS112A



SN54S112, SN74S112A



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

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage: 'LS112A	7 V
SN54LS112, SN74LS112A	5.5 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

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

SN54LS112A, SN74LS112A

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

recommended operating conditions

		SN54LS112A			SN74LS112A			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		30	0		30	MHz
t_w	Pulse duration	CLK high		20		20		ns
		\overline{PRE} or \overline{CLR} low		25		25		
t_{su}	Set up time-before CLK↓	Data high or low		20		20		ns
		\overline{CLR} inactive		25		25		
		\overline{PRE} inactive		20		20		
t_h	Hold time-data after CLK↓	0			0			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†	SN54LS112A			SN74LS112A			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}		$V_{CC} = \text{MIN}$, $V_{IL} = \text{MAX}$, $V_{IH} = 2 \text{ V}$, $I_{OL} = 4 \text{ mA}$	0.25	0.4		0.25	0.4		V
		$V_{CC} = \text{MIN}$, $V_{IL} = \text{MAX}$, $V_{IH} = 2 \text{ V}$, $I_{OL} = 8 \text{ mA}$				0.35	0.5		
I_I	J or K	$V_{CC} = \text{MAX}$, $V_I = 7 \text{ V}$			0.1			0.1	mA
	\overline{CLR} or \overline{PRE}				0.3			0.3	
	CLK				0.4			0.4	
I_{IH}	J or K	$V_{CC} = \text{MAX}$, $V_I = 2.7 \text{ V}$			20			20	μA
	\overline{CLR} or \overline{PRE}				60			60	
	CLK				80			80	
I_{IL}	J or K	$V_{CC} = \text{MAX}$, $V_I = 0.4 \text{ V}$			-0.4			-0.4	mA
	All other				-0.8			-0.8	
I_{OS}^{\S}		$V_{CC} = \text{MAX}$, see Note 2	-20		-100	-20		-100	mA
I_{CC} (Total)		$V_{CC} = \text{MAX}$, see Note 3		4	6		4	6	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.

NOTES: 2. 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 V for the '54 family and the '74 family, respectively, with the minimum and maximum limits reduced to one half of their stated values.

3. 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.

TEXAS
INSTRUMENTS

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

SN54LS112A, SN74LS112A
DUAL J-K NEGATIVE-EDGE-TRIGGERED
FLIP-FLOPS WITH PRESET AND CLEAR

switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$ (see Note 4)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
f_{\max}			$R_L = 2\text{ k}\Omega$, $C_L = 15\text{ pF}$	30	45		MHz	
t_{PLH}	$\overline{\text{CLR}}$, $\overline{\text{PRE}}$ or CLK	Q or $\overline{\text{Q}}$			15	20		ns
t_{PHL}					15	20		ns

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.

TEXAS 
INSTRUMENTS

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

SN54S112, SN74S112A
DUAL J-K NEGATIVE-EDGE-TRIGGERED
FLIP-FLOPS WITH PRESET AND CLEAR

recommended operating conditions

		SN54S112			SN74S112A			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	-1			-1			mA
I _{OL}	Low-level output current	20			20			mA
t _w	Pulse duration	CLK high		6	6		ns	
		CLK low		6.5	6.5			
		PRE or CLR low		8	8			
t _{SU}	Set up time-before CLK↓	Data high or low		7	7		ns	
t _H	Hold time-data after CLK↓	0			0			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†		SN54S112			SN74S112A			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V _{IK}		V _{CC} = MIN, I _I = -18 mA		-1.2			-1.2			V
V _{OH}		V _{CC} = MIN, I _{OH} = -1 mA, V _{IH} = 2 V, V _{IL} = MAX,		2.5	3.4		2.7	3.4		V
V _{OL}		V _{CC} = MIN, I _{OL} = 20 mA, V _{IH} = 2 V, V _{IL} = 0.8 V,		0.5			0.5			V
I _I		V _{CC} = MAX, V _I = 5.5 V		1			1			mA
I _{IH}	J or K	V _{CC} = MAX, V _I = 2.7 V		50			50			μA
	All other			100			100			
I _{IL}	J or K	V _{CC} = MAX, V _I = 0.5 V		-1.6			-1.6			mA
	CLR‡			-7			-7			
	PRE‡			-7			-7			
	CLK			-4			-4			
I _{OS} †		V _{CC} = MAX		-40	-100		-40	-100	mA	
I _{CC} #		V _{CC} = MAX, see Note 3		15	25		15	25	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.

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

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

Values are average per flip-flop.

NOTE 3: With all outputs open, I_{CC} is measured with the Q and Q̄ outputs high in turn. At the time of measurement, the clock input is grounded.



SN54S112, SN74S112A
DUAL J-K NEGATIVE-EDGE-TRIGGERED
FLIP-FLOPS WITH PRESET AND CLEAR

switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$ (see Note 4)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}			$R_L = 280\ \Omega, \quad C_L = 15\ \text{pF}$	80	125		MHz
t_{PLH}	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$	Q or $\overline{\text{Q}}$			4	7	ns
t_{PHL}	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ (CLK high)	$\overline{\text{Q}}$ or Q			5	7	ns
	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ (CLK low)				5	7	
t_{PLH}	CLK	Q or $\overline{\text{Q}}$			4	7	ns
t_{PHL}					5	7	ns

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.

IMPORTANT NOTICE

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

TI warrants performance of its semiconductor products and related software to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Certain applications using semiconductor products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications").

TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS.

Inclusion of TI products in such applications is understood to be fully at the risk of the customer. Use of TI products in such applications requires the written approval of an appropriate TI officer. Questions concerning potential risk applications should be directed to TI through a local SC sales office.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TI warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.