

# 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  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74LS112A and SN74S112A are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

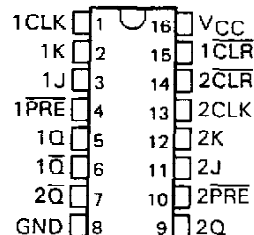
FUNCTION TABLE (each flip-flop)

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 <sup>†</sup>	H <sup>†</sup>
H	H	↓	L	L	Q <sub>0</sub>	$\bar{Q}_0$
H	H	↓	H	L	H	L
H	H	↓	L	H	L	H
H	H	↓	H	H	TOGGLE	TOGGLE
H	H	H	X	X	Q <sub>0</sub>	$\bar{Q}_0$

<sup>†</sup> 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.

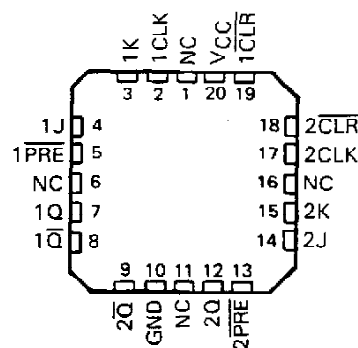
SN54LS112A, SN54S112 . . . J OR W PACKAGE  
SN74LS112A, SN74S112A . . . D OR N PACKAGE

(TOP VIEW)



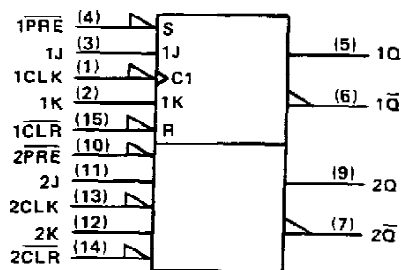
SN54LS112A, SN54S112 . . . FK PACKAGE

(TOP VIEW)



NC—No internal connection

## logic symbol<sup>†</sup>



<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, N, and W packages.

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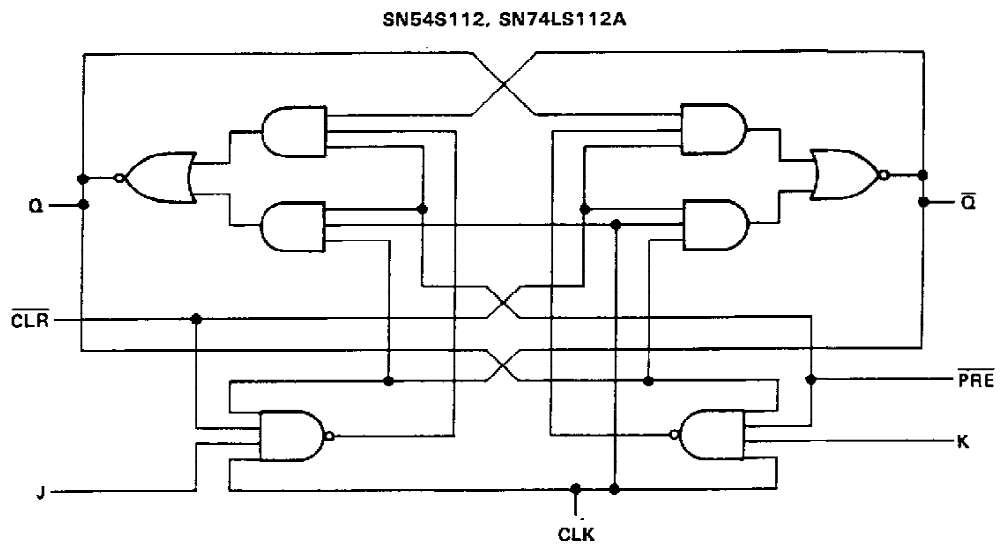
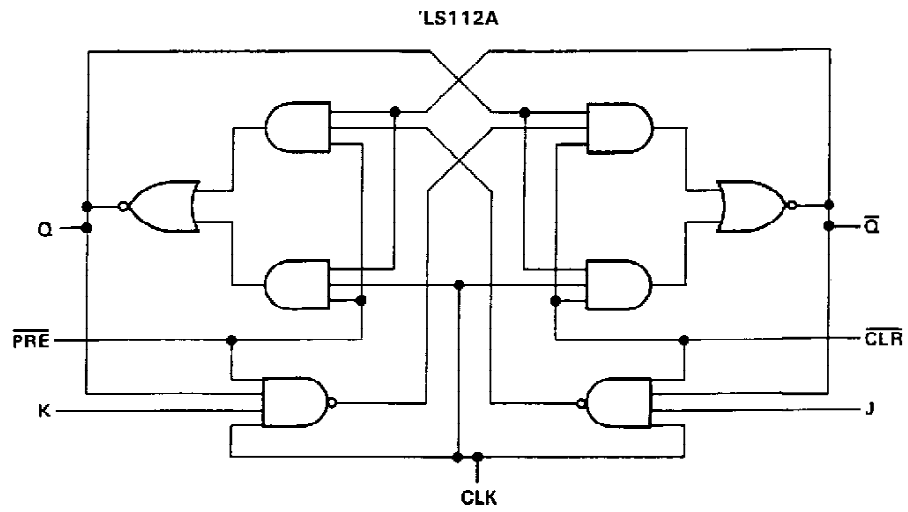
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**SN54LS112A, SN54S112, SN74LS112A, SN74S112A**  
**DUAL J-K NEGATIVE-EDGE-TRIGGERED**  
**FLIP-FLOPS WITH PRESET AND CLEAR**

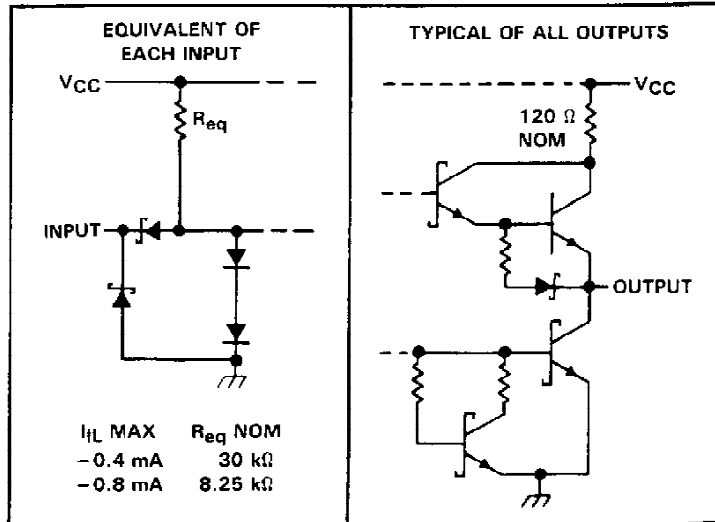
logic diagrams (positive logic)



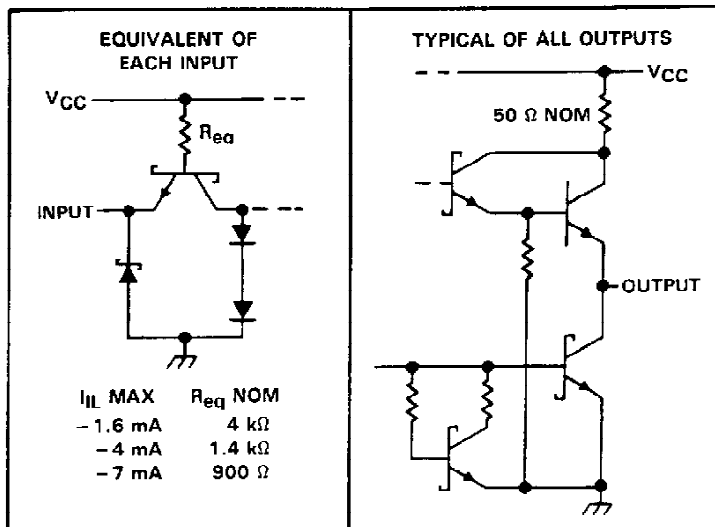
**SN54LS112A, SN54S112, SN74LS112A, SN74S112A**  
**DUAL J-K NEGATIVE-EDGE-TRIGGERED**  
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schematics of inputs and outputs

'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.

  
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# 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
		PRE or CLR low	25		25			
$t_{su}$	Set up time-before CLK↓	Data high or low	20		20			ns
		CLR inactive	25		25			
		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	
	CLR or 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	$\mu\text{A}$	
	CLR or 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  $2.125 \text{ V}$  for the '54 family and the '74 family, respectively, with the minimum and maximum limits reduced to one half of their stated values.

3. 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.

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**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.

**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 <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			V
I <sub>OH</sub>	High-level output current				-1			mA
I <sub>OL</sub>	Low-level output current				20			mA
t <sub>w</sub>	Pulse duration	CLK high		6	6		ns	
		CLK low		6.5	6.5			
		PRE or CLR low		8	8			
t <sub>su</sub>	Set up time-before CLK↓	Data high or low		7	7		ns	
t <sub>h</sub>	Hold time-data after CLK↓	0			0			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†		SN54S112			SN74S112A			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V <sub>IK</sub>		V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA		-1.2			-1.2			V
V <sub>OH</sub>		V <sub>CC</sub> = MIN, I <sub>OH</sub> = -1 mA, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX.		2.5	3.4		2.7	3.4		V
V <sub>OL</sub>		V <sub>CC</sub> = MIN, I <sub>OL</sub> = 20 mA, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V.		0.5			0.5			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	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V		50			50			μA
	All other			100			100			
I <sub>IL</sub>	J or K	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.5 V		-1.6			-1.6			mA
	CLR‡			-7			-7			
	PRE‡			-7			-7			
	CLK			-4			-4			
I <sub>OS</sub> †		V <sub>CC</sub> = MAX		-40	-100		-40	-100	mA	
I <sub>CC</sub> #		V <sub>CC</sub> = 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<sub>CC</sub> = 5 V, T<sub>A</sub> = 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<sub>CC</sub> is measured with the Q and  $\bar{Q}$  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 $\overline{Q}$			4	7	ns
$t_{PHL}$	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ (CLK high)	$\overline{Q}$ or $Q$			5	7	ns
	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ (CLK low)				5	7	
$t_{PLH}$	CLK	$Q$ or $\overline{Q}$			4	7	ns
$t_{PHL}$					5	7	ns

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



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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>
JM38510/07102BEA	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
JM38510/07102BFA	ACTIVE	CFP	W	16	1	None	Call TI	Level-NC-NC-NC
JM38510/30103B2A	ACTIVE	LCCC	FK	20	1	None	Call TI	Level-NC-NC-NC
JM38510/30103BEA	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
JM38510/30103BFA	ACTIVE	CFP	W	16	1	None	Call TI	Level-NC-NC-NC
SN54LS112AJ	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
SN54S112J	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
SN74LS112AD	ACTIVE	SOIC	D	16	40	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74LS112ADR	ACTIVE	SOIC	D	16	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74LS112AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74LS112AN3	OBSOLETE	PDIP	N	16		None	Call TI	Call TI
SN74LS112ANSR	ACTIVE	SO	NS	16	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74S112AD	OBSOLETE	SOIC	D	16		None	Call TI	Call TI
SN74S112ADR	ACTIVE	SOIC	D	16	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74S112AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74S112AN3	OBSOLETE	PDIP	N	16		None	Call TI	Call TI
SN74S112ANSR	ACTIVE	SO	NS	16	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SNJ54LS112AFK	ACTIVE	LCCC	FK	20	1	None	Call TI	Level-NC-NC-NC
SNJ54LS112AJ	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
SNJ54LS112AW	ACTIVE	CFP	W	16	1	None	Call TI	Level-NC-NC-NC
SNJ54S112FK	ACTIVE	LCCC	FK	20	1	None	Call TI	Level-NC-NC-NC
SNJ54S112J	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
SNJ54S112W	ACTIVE	CFP	W	16	1	None	Call TI	Level-NC-NC-NC

<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.

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

<sup>(2)</sup> Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**None:** Not yet available Lead (Pb-Free).

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**Green (RoHS & no Sb/Br):** TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

<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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		Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
		Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
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