

# SN5476, SN54LS76A SN7476, SN74LS76A DUAL J-K FLIP-FLOPS WITH PRESET AND CLEAR

SDLS121 – DECEMBER 1983 – REVISED MARCH 1988

- Package Options Include Plastic and Ceramic DIPs and Ceramic Flat Packages
- Dependable Texas Instruments Quality and Reliability

SN5476, SN54LS76A . . . J PACKAGE  
SN7476 . . . N PACKAGE  
SN74LS76A . . . D OR N PACKAGE  
(TOP VIEW)



## description

The '76 contains two independent J-K flip-flops with individual J-K, clock, preset, and clear inputs. The '76 is a positive-edge-triggered flip-flop. J-K input is loaded into the master while the clock is high and transferred to the slave on the high-to-low transition. For these devices the J and K inputs must be stable while the clock is high.

The 'LS76A contain two independent negative-edge-triggered flip-flops. The J and K inputs must be stable one setup time prior to the high-to-low clock transition for predicatble operation. The preset and clear are asynchronous active low inputs. When low they override the clock and data inputs forcing the outputs to the steady state levels as shown in the function table.

The SN5476 and the SN54LS76A are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7476 and the SN74LS76A are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

'76  
FUNCTION TABLE

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 <sup>†</sup>	H <sup>†</sup>
H	H	↓	L	L	Q <sub>0</sub>	Q̄ <sub>0</sub>
H	H	↓	H	L	H	L
H	H	↓	L	H	L	H
H	H	↓	H	H	TOGGLE	
H	H	↓	L	L	Q <sub>0</sub>	Q̄ <sub>0</sub>

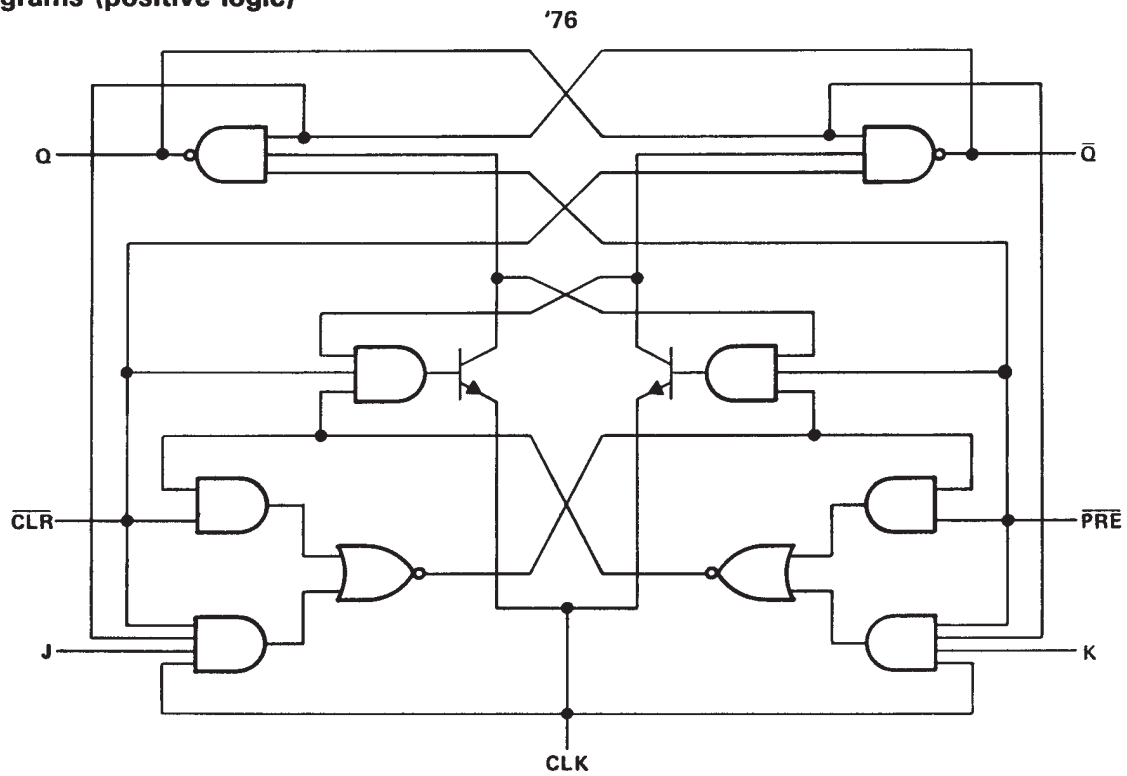
'LS76A  
FUNCTION TABLE

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 <sup>†</sup>	H <sup>†</sup>
H	H	↓	L	L	Q <sub>0</sub>	Q̄ <sub>0</sub>
H	H	↓	H	L	H	L
H	H	↓	L	H	L	H
H	H	↓	H	H	TOGGLE	
H	H	↓	L	L	Q <sub>0</sub>	Q̄ <sub>0</sub>

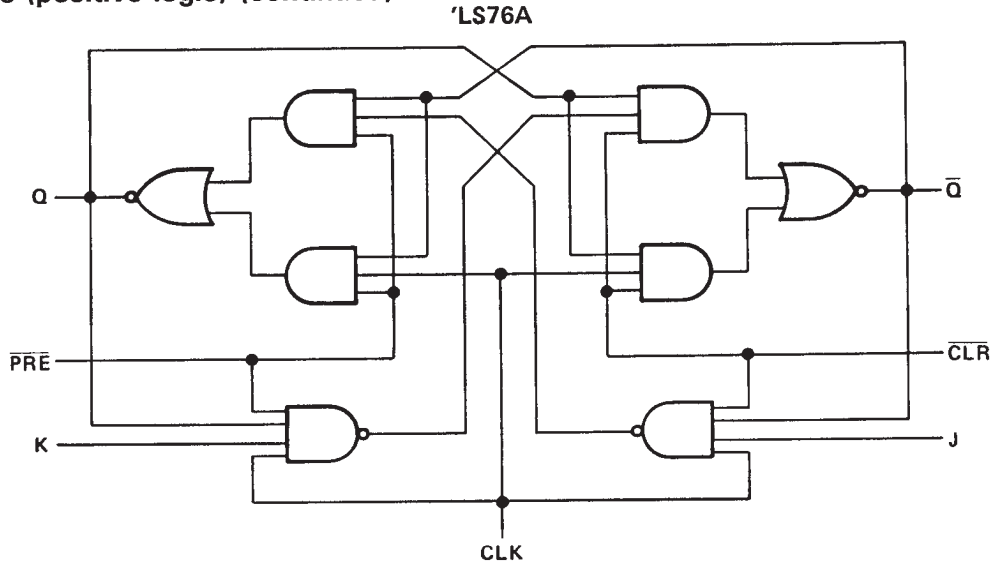
<sup>†</sup> This configuration is nonstable; that is, it will not persist when either preset or clear returns to its inactive (high) level.

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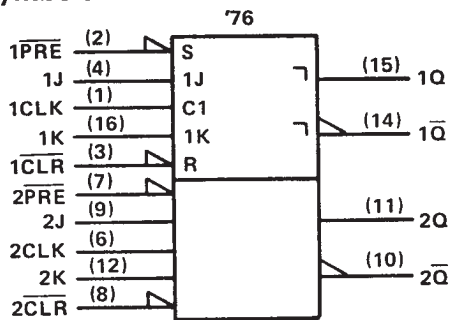
logic diagrams (positive logic)



logic diagrams (positive logic) (continued)

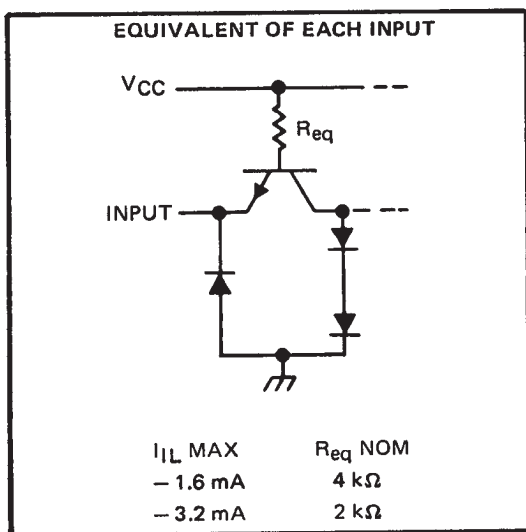


logic symbols†

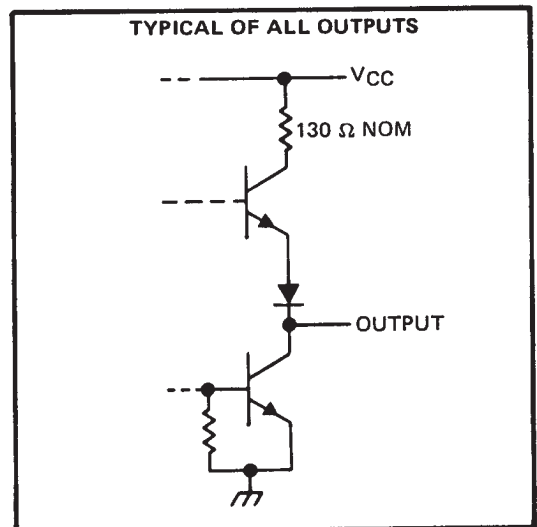


†These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

schematics of inputs and outputs



'76

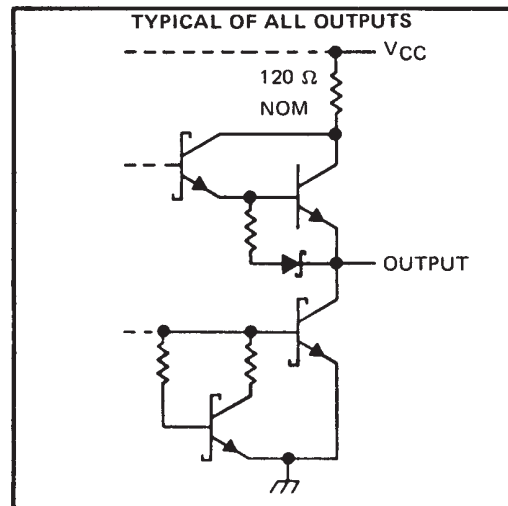
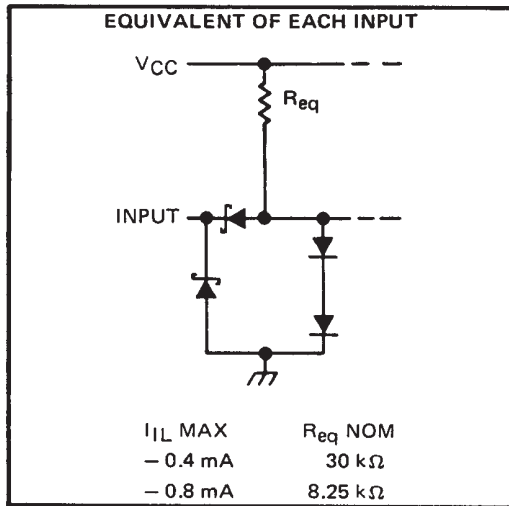


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schematics of inputs and outputs (continued)

'LS76A



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

Supply voltage, $V_{CC}$ (see Note 1) .....	7 V
Input voltage: '76 .....	5.5 V
'LS76A .....	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.

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SN7476, SN74LS76A  
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**recommended operating conditions**

		SN5476			SN7476			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	– 0.4			– 0.4			mA
I <sub>OL</sub>	Low-level output current	16			16			mA
t <sub>w</sub>	Pulse duration	CLK high		20	20		ns	
		CLK low		47	47			
		PRE or CLR low		25	25			
t <sub>su</sub>	Input setup time before CLK ↑	0			0			ns
t <sub>h</sub>	Input 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†	SN5476			SN7476			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
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> = – 0.4 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
	All other	80			80			
I <sub>IL</sub>	J or K	– 1.6			– 1.6			mA
	All other	– 3.2			– 3.2			
I <sub>OS</sub> §	V <sub>CC</sub> = MAX	– 20	– 57		– 18	– 57		mA
I <sub>CC</sub> #	V <sub>CC</sub> = MAX, See Note 2	10 20			10 20			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  $\bar{Q}$  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>					15	20		MHz
t <sub>PLH</sub>	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$	Q or $\bar{Q}$	R <sub>L</sub> = 400 Ω, C <sub>L</sub> = 15 pF		16	25		ns
t <sub>PHL</sub>					25	40		ns
t <sub>PLH</sub>	CLK	Q or $\bar{Q}$			16	25		ns
t <sub>PHL</sub>					25	40		ns

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



**SN5476, SN54LS76A**  
**SN7476, SN74LS76A**  
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**recommended operating conditions**

		SN54LS76A			SN74LS76A			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage	4.5	5	5.5	4.75	5	5.75	V
V <sub>IH</sub>	High-level input voltage	2			2			V
V <sub>IL</sub>	Low-level input voltage			0.7			0.8	V
I <sub>OH</sub>	High-level output current			-0.4			-0.4	mA
I <sub>OL</sub>	Low-level output current			4			8	mA
f <sub>clock</sub>	Clock frequency	0		30	0		30	MHz
t <sub>w</sub>	Pulse duration	CLK high		20			20	ns
		$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ low		25			25	
t <sub>su</sub>	Setup time before CLK↓	data high or low		20			20	ns
		$\overline{\text{CLR}}$ inactive		20			20	
		$\overline{\text{PRE}}$ inactive		25			25	
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†	SN54LS76A			SN74LS76A			UNIT	
			MIN	TYP‡	MAX	MIN	TYP‡	MAX		
V <sub>IK</sub>		V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 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> = MAX, I <sub>OH</sub> = -0.4 mA	2.5	3.4		2.7	3.4		V	
V <sub>OL</sub>		V <sub>CC</sub> = MIN, V <sub>IL</sub> = MAX, V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 4 mA		0.25	0.4		0.25	0.4	V	
		V <sub>CC</sub> = MIN, V <sub>IL</sub> = MAX, V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 8 mA					0.35	0.5		
I <sub>I</sub>	J or K	V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V			0.1			0.1	mA	
	$\overline{\text{CLR}}$ or $\overline{\text{PRE}}$				0.3			0.3		
	CLK				0.4			0.4		
I <sub>IH</sub>	J or K	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V			20			20	μA	
	$\overline{\text{CLR}}$ or $\overline{\text{PRE}}$				60			60		
	CLK				80			80		
I <sub>IL</sub>	J or K	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V			-0.4			-0.4	mA	
	All other				-0.8			-0.8		
I <sub>OS</sub> §		V <sub>CC</sub> = MAX, See Note 4	-20		-100			-20	-100	mA
I <sub>CC</sub> (Total)		V <sub>CC</sub> = MAX, See Note 2		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<sub>CC</sub> = 5 V, T<sub>A</sub> = 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<sub>CC</sub> is measured with the Q and  $\overline{\text{Q}}$  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<sub>O</sub> = 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<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>					30	45		MHz
t <sub>PLH</sub>	$\overline{\text{PRE}}$ , $\overline{\text{CLR}}$ or CLK	Q or $\overline{\text{Q}}$	R <sub>L</sub> = 2 kΩ,	C <sub>L</sub> = 15 pF		15	20	ns
t <sub>PHL</sub>						15	20	ns

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



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