Signetics

7476, LS76
Flip-Flops

Dual J-K Flip-Flop
Product Specification

Logic Products

DESCRIPTION

The '76 is a dual J-K flip-flop with individual J, K, Clock, Set and Reset inputs. The 7476 is positive pulse-triggered. JK information is loaded into the master while the Clock is HIGH and transferred to the slave on the HIGH-to-LOW Clock transition. The J and K inputs must be stable while the Clock is HIGH for conventional operation.

The 74LS76 is a negative edge-triggered flip-flop. The J and K inputs must be stable only one set-up time prior to the HIGH-to-LOW Clock transition.

The Set ($\overline{S}_D$) and Reset ($\overline{R}_D$) 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.

TYPE	TYPICAL f_{MAX}	TYPICAL SUPPLY CURRENT (TOTAL)
7476	20MHz	10mA
74LS76	45MHz	4mA

ORDERING CODE

PACKAGES	COMMERCIAL RANGE V_{CC} = 5V ±5%; T_A = 0°C to +70°C
Plastic DIP	N7476N, N74LS76N

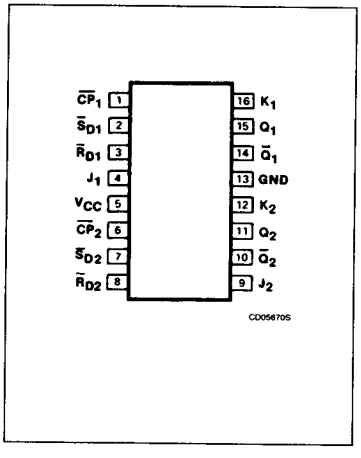
NOTE:
For information regarding devices processed to Military Specifications, see the Signetics Military Products Data Manual.

INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

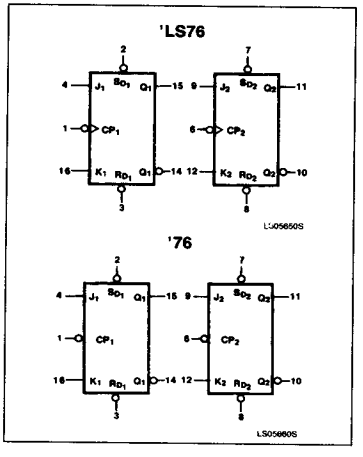
PINS	DESCRIPTION	74	74LS
$\overline{CP}$	Clock input	2ul	2LSul
$\overline{R}_D$, $\overline{S}_D$	Reset and Set inputs	2ul	2LSul
J, K	Data inputs	1ul	1LSul
Q, $\overline{Q}$	Outputs	10ul	10LSul

NOTE:
Where a 74 unit load (ul) is understood to be 40μA I_{IH} and −1.6mA I_{IL}, and a 74LS unit load (LSul) is 20μA I_{IH} and −0.4mA I_{IL}.

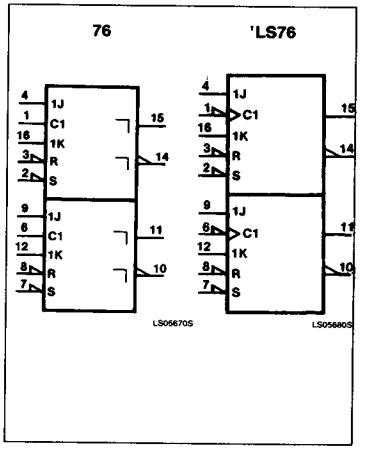
PIN CONFIGURATION



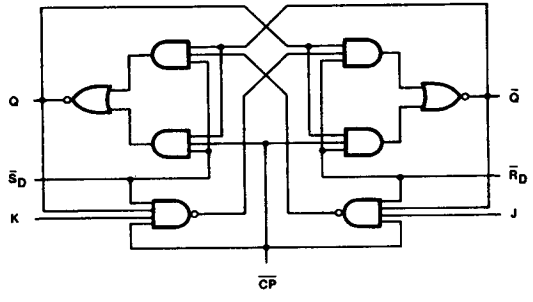
LOGIC SYMBOL



LOGIC SYMBOL (IEE/IEC)



LOGIC DIAGRAM



FUNCTION TABLE

OPERATING MODE	INPUTS					OUTPUTS	
	$\bar{S}_D$	$\bar{R}_D$	$\overline{CP}$(2)	J	K	Q	$\bar{Q}$
Asynchronous set	L	H	X	X	X	H	L
Asynchronous reset (Clear)	H	L	X	X	X	L	H
Undetermined(1)	L	L	X	X	X	H	H
Toggle	H	H	⎍	h	h	$\bar{q}$	q
Load "0" (Reset)	H	H	⎍	l	h	L	H
Load "1" (Set)	H	H	⎍	h	l	H	L
Hold "no change"	H	H	⎍	l	l	q	$\bar{q}$

H = HIGH voltage level steady state.
h = HIGH voltage level one set-up time prior to the HIGH-to-LOW Clock transition.(3)
L = LOW voltage level steady state.
l = LOW voltage level one set-up time prior to the HIGH-to-LOW Clock transition.(3)
q = Lower case letters indicate the state of the referenced output prior to the HIGH-to-LOW Clock transition.
X = Don't care.
⎍ = Positive Clock pulse.

NOTES:
1. Both outputs will be HIGH while both $\bar{S}_D$ and $\bar{R}_D$ are LOW, but the output states are unpredictable if $\bar{S}_D$ and $\bar{R}_D$ go HIGH simultaneously.
2. The 74LS76 is edge triggered. Data must be stable one set-up time prior to the negative edge of the Clock for predictable operation.
3. The J and K inputs of the 7476 must be stable while the Clock is HIGH for conventional operation.

ABSOLUTE MAXIMUM RATINGS (Over operating free-air temperature range unless otherwise noted.)

PARAMETER		74	74LS	UNIT
V_{CC}	Supply voltage	7.0	7.0	V
V_{IN}	Input voltage	−0.5 to +5.5	−0.5 to +7.0	V
I_{IN}	Input current	−30 to +5	−30 to +1	mA
V_{OUT}	Voltage applied to output in HIGH output state	−0.5 to $+V_{CC}$	−0.5 to $+V_{CC}$	V
T_A	Operating free-air temperature range	0 to 70		°C

RECOMMENDED OPERATING CONDITIONS

PARAMETER		74			74LS			UNIT
		Min	Nom	Max	Min	Nom	Max	
V_{CC}	Supply voltage	4.75	5.0	5.25	4.75	5.0	5.25	V
V_{IH}	HIGH-level input voltage	2.0			2.0			V
V_{IL}	LOW-level input voltage			+0.8			+0.8	V
I_{IK}	Input clamp current			−12			−18	mA
I_{OH}	HIGH-level output current			−400			−400	μA
I_{OL}	LOW-level output current			16			8	mA
T_A	Operating free-air temperature	0		70	0		70	°C

DC ELECTRICAL CHARACTERISTICS (Over recommended operating free-air temperature range unless otherwise noted.)

PARAMETER		TEST CONDITIONS[1]			7476			74LS76			UNIT
					Min	Typ[2]	Max	Min	Typ[2]	Max	
V_{OH}	HIGH-level output voltage	V_{CC} = MIN, V_{IH} = MIN, V_{IL} = MAX, I_{OH} = MAX			2.4	3.4		2.7	3.4		V
V_{OL}	LOW-level output voltage	V_{CC} = MIN, V_{IL} = MAX, V_{IH} = MIN	I_{OL} = MAX			0.2	0.4		0.35	0.5	V
			I_{OL} = 4mA (74LS)						0.25	0.4	V
V_{IK}	Input clamp voltage	V_{CC} = MIN, I_I = I_{IK}					−1.5			−1.5	V
I_I	Input current at maximum input voltage	V_{CC} = MAX	V_I = 5.5V				1.0				mA
			V_I = 7.0V	J, K Inputs						0.1	mA
				$\overline{S}_D$, $\overline{R}_D$ Inputs						0.3	mA
				$\overline{CP}$ Inputs						0.4	mA
I_{IH}	HIGH-level input current	V_{CC} = MAX	V_I = 2.4V	J, K Inputs			40				μA
				$\overline{S}_D$, $\overline{R}_D$ Inputs			80				μA
				$\overline{CP}$ Inputs			80				μA
			V_I = 2.7V	J, K Inputs						20	μA
				$\overline{S}_D$, $\overline{R}_D$ Inputs						60	μA
				$\overline{CP}$ Inputs						80	μA
I_{IL}	LOW-level input current[5]	V_{CC} = MAX, V_I = 0.4V		J, K Inputs			−1.6			−0.4	mA
				$\overline{S}_D$, $\overline{R}_D$ Inputs			−3.2			−0.8	mA
				$\overline{CP}$ Inputs			−3.2			−0.8	mA
I_{OS}	Short-circuit output current[3]	V_{CC} = MAX			−18		−57	−20		−100	mA
I_{CC}	Supply current[4] (total)	V_{CC} = MAX				10	40		4	8	mA

NOTES:
1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
2. All typical values are at V_{CC} = 5V, T_A = 25°C.
3. I_{OS} is tested with V_{OUT} = +0.5V and V_{CC} = V_{CC} MAX + 0.5V. Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.
4. With the Clock input grounded and all outputs open. I_{CC} is measured with the Q and $\overline{Q}$ outputs HIGH in turn.
5. $\overline{S}_D$ is tested with $\overline{R}_D$ HIGH, and $\overline{R}_D$ is tested with $\overline{S}_D$ HIGH.

AC ELECTRICAL CHARACTERISTICS T_A = 25°C, V_{CC} = 5.0V

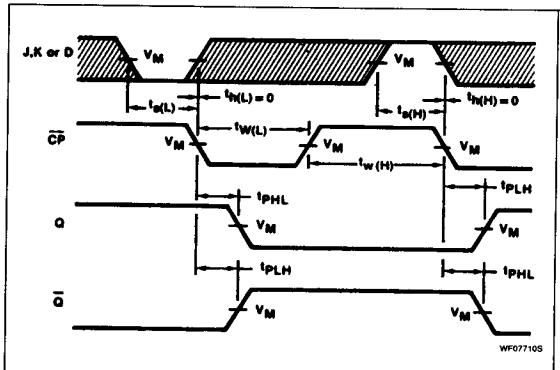
PARAMETER		TEST CONDITIONS	74		74LS		UNIT
			C_L = 15pF, R_L = 400Ω		C_L = 15pF, R_L = 2kΩ		
			Min	Max	Min	Max	
f_{MAX}	Maximum clock frequency	Waveform 3	15		30		MHz
t_{PLH} t_{PHL}	Propagation delay Clock to output	Waveform 1, 'LS76 Waveform 3, '76		25 40		20 30	ns
t_{PLH} t_{PHL}	Propagation delay $\overline{S}_D$ or $\overline{R}_D$ to output	Waveform 2		25 40		20 30	ns

NOTE:
Per industry convention, f_{MAX} is the worst case value of the maximum device operating frequency with no constraints on t_r, t_f, pulse width of duty cycle.

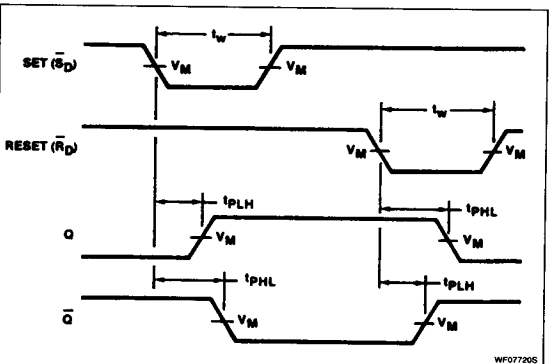
AC SET-UP REQUIREMENTS $T_A = 25°C$, $V_{CC} = 5.0V$

PARAMETER		TEST CONDITIONS	74		74LS		UNIT
			Min	Max	Min	Max	
$t_W(H)$	Clock pulse width (HIGH)	Waveform 1	20		20		ns
$t_W(L)$	Clock pulse width (LOW)	Waveform 1	47				ns
$t_W(L)$	Reset pulse width (LOW)	Waveform 2	25		25		ns
t_S	Set-up time J or K to Clock(C)	Waveform 1	0		20		ns
t_h	Hold time J or K to Clock	Waveform 1	0		0		ns

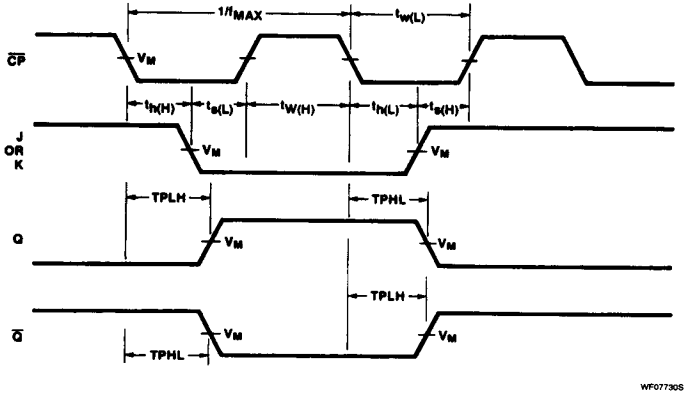
AC WAVEFORMS



Waveform 1. Clock To Output Delays, Data Set-up And Hold Times, Clock Pulse Width



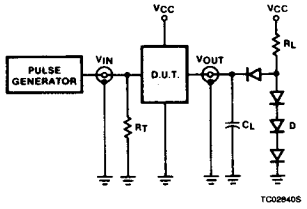
Waveform 2. Set And Reset To Output Delays, Set And Reset Pulse Widths

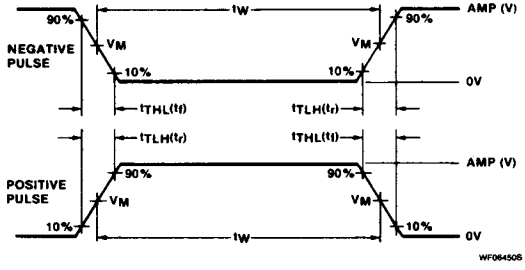


For all waveforms, $V_M = 1.3V$ for 74S; $V_M = 1.5V$ for all other TTL families.
The shaded areas indicate when the input is permitted to change for predictable output performance.

Waveform 3. Propagation Delay and f_{MAX}

TEST CIRCUITS AND WAVEFORMS





Test Circuit For 74 Totem-Pole Outputs

DEFINITIONS
R_L = Load resistor to V_{CC}; see AC CHARACTERISTICS for value.
C_L = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.
R_T = Termination resistance should be equal to Z_{OUT} of Pulse Generators.
D = Diodes are 1N916, 1N3064, or equivalent.
t_{TLH}, t_{THL} Values should be less than or equal to the table entries.

V_M = 1.3V for 74LS; V_M = 1.5V for all other TTL families.

Input Pulse Definition

FAMILY	INPUT PULSE REQUIREMENTS				
	Amplitude	Rep. Rate	Pulse Width	t_{TLH}	t_{THL}
74	3.0V	1MHz	500ns	7ns	7ns
74LS	3.0V	1MHz	500ns	15ns	6ns
74S	3.0V	1MHz	500ns	2.5ns	2.5ns

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