

Dual J–K negative edge-triggered flip-flops without reset

74F113

FEATURE

- Industrial temperature range available (-40°C to $+85^{\circ}\text{C}$)

DESCRIPTION

The 74F113, dual negative edge-triggered JK-type flip-flop, features individual J, K, clock ($\overline{\text{CP}}$), set ($\overline{\text{SD}}$) inputs, true and complementary outputs. The asynchronous $\overline{\text{SD}}$ input, when low, forces the outputs to the steady state levels as shown in the function table regardless of the level at the other inputs.

A high level on the clock ($\overline{\text{CP}}$) input enables the J and K inputs and data will be accepted. The logic levels at the J and K inputs may be allowed to change while the $\overline{\text{CP}}$ is high and flip-flop will perform according to the function table as long as minimum setup and hold times are observed. Output changes are initiated by the high-to-low transition of the $\overline{\text{CP}}$.

TYPE	TYPICAL f_{max}	TYPICAL SUPPLY CURRENT(TOTAL)
74F113	100MHz	15mA

ORDERING INFORMATION

DESCRIPTION	ORDER CODE	
	COMMERCIAL RANGE $V_{\text{CC}} = 5\text{V} \pm 10\%$, $T_{\text{amb}} = 0^{\circ}\text{C}$ to $+70^{\circ}\text{C}$	INDUSTRIAL RANGE $V_{\text{CC}} = 5\text{V} \pm 10\%$, $T_{\text{amb}} = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
14-pin plastic DIP	N74F113N	I74F113N
14-pin plastic SO	N74F113D	I74F109D

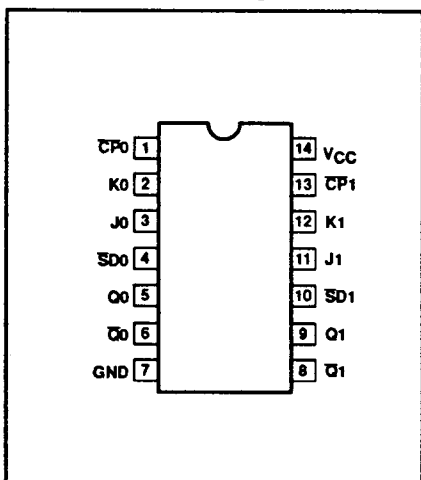
INPUT AND OUTPUT LOADING AND FAN OUT TABLE

PINS	DESCRIPTION	74F (U.L.) HIGH/LOW	LOAD VALUE HIGH/LOW
J0, J1	J inputs	1.0/1.0	20 μA /0.6mA
K0, K1	K inputs	1.0/1.0	20 μA /0.6mA
$\overline{\text{CP}}0, \overline{\text{CP}}1$	Clock inputs (active falling edge)	1.0/4.0	20 μA /2.4mA
$\overline{\text{SD}}0, \overline{\text{SD}}1$	Set inputs (active low)	1.0/5.0	20 μA /3.0mA
Q0, Q1, $\overline{\text{Q}}0, \overline{\text{Q}}1$	Data outputs	50/33	1.0mA/20mA

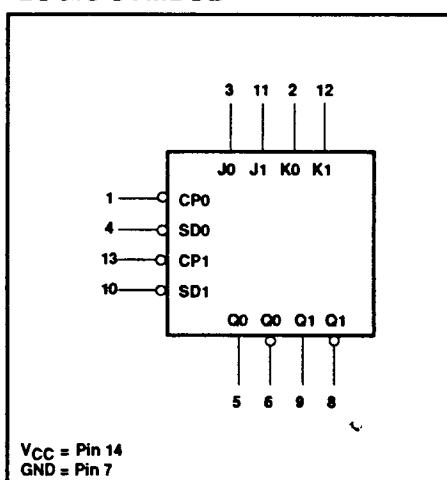
Note to input and output loading and fan out table

- One (1.0) FAST unit load is defined as: 20 μA in the high state and 0.6mA in the low state.

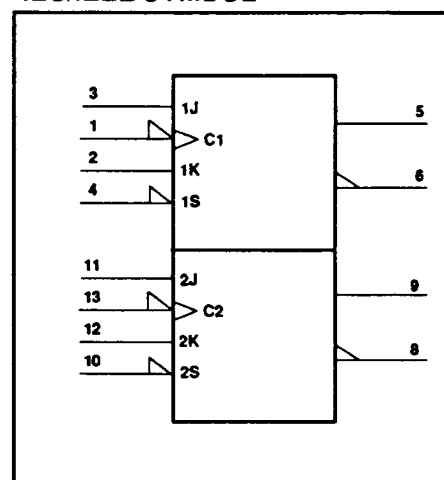
PIN CONFIGURATION



LOGIC SYMBOL



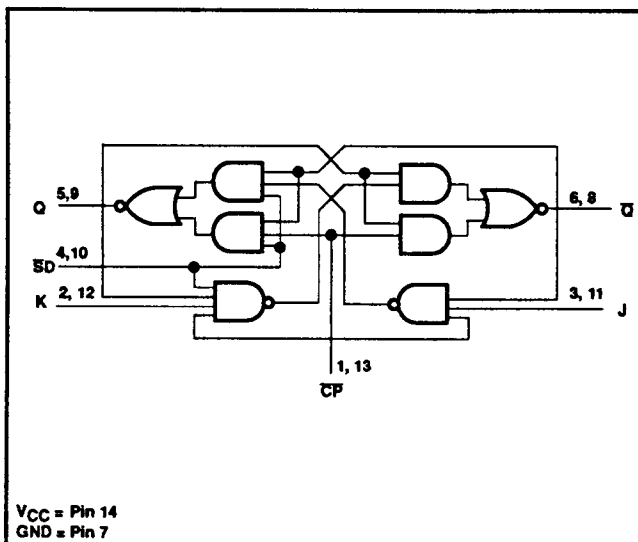
IEC/IEEE SYMBOL



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LOGIC DIAGRAM



FUNCTION TABLE

INPUTS				OUTPUTS		OPERATING MODE
SD	CP	J	K	Q	\bar{Q}	
L	X	X	X	H	L	Asynchronous set
H	↓	h	h	\bar{q}	q	Toggle
H	↓	h	l	H	L	Load "1" (set)
H	↓	l	h	L	H	Load "0" (reset)
H	↓	l	l	q	\bar{q}	Hold "no change"

Notes to function table

- H = High-voltage level
- h = High-voltage level one setup time prior to high-to-low clock transition
- L = Low-voltage level
- l = Low-voltage level one setup time prior to high-to-low clock transition
- q = Lower case indicate the state of the referenced output prior to the high-to-low clock transition
- X = Don't care
- ↓ = high-to-low clock transition

ABSOLUTE MAXIMUM RATINGS

(Operation beyond the limit set forth in this table may impair the useful life of the device. Unless otherwise noted these limits are over the operating free air temperature range.)

SYMBOL	PARAMETER	RATING	UNIT	
V_{CC}	Supply voltage	-0.5 to +7.0	V	
V_{IN}	Input voltage	-0.5 to +7.0	V	
I_{IN}	Input current	-30 to +5	mA	
V_{OUT}	Voltage applied to output in high output state	-0.5 to V_{CC}	V	
I_{OUT}	Current applied to output in low output state	40	mA	
T_{amb}	Operating free air temperature range	Commercial range	0 to +70	°C
		Industrial range	-40 to +85	°C
T_{stg}	Storage temperature range	-65 to +150	°C	

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS			UNIT
		MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5.0	5.5	V
V_{IN}	High-level input voltage	2.0			V
V_{IL}	Low-level input voltage			0.8	V
I_{IK}	Input clamp current			-18	mA
I_{OH}	High-level output current			-1	mA
I_{OL}	Low-level output current			20	mA
T_{amb}	Operating free air temperature range	Commercial range	0	+70	°C
		Industrial range	-40	+85	°C

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DC ELECTRICAL CHARACTERISTICS

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

SYMBOL	PARAMETER	TEST CONDITIONS ¹			LIMITS			UNIT
					MIN	TYP ²	MAX	
V _{OH}	High-level output voltage	V _{CC} = MIN, V _{IL} = MAX, V _H = MIN	I _{OH} = MAX	±10%V _{CC}	2.5			V
				±5%V _{CC}	2.7	3.4		V
V _{OL}	Low-level output voltage	V _{CC} = MIN, V _{IL} = MAX, V _H = MIN	I _{OL} = MAX	±10%V _{CC}		0.30	0.50	V
				±5%V _{CC}		0.30	0.50	V
V _{IK}	Input clamp voltage	V _{CC} = MIN, I _I = I _{IK}				-0.73	-1.2	V
I _I	Input current at maximum input voltage	V _{CC} = MAX, V _I = 7.0V					100	μA
I _{IH}	High-level input current	V _{CC} = MAX, V _I = 2.7V					20	μA
I _{IL}	Low-level input current	V _{CC} = MAX, V _I = 0.5V	J _n , K _n				-0.6	mA
			CP _n				-2.4	mA
			SD _n				-3.0	mA
I _{OS}	Short-circuit output current ³	V _{CC} = MAX			-60		-150	mA
I _{CC}	Supply current ⁴ (total)	V _{CC} = MAX				15	21	mA

Notes to DC electrical characteristics

- For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
- All typical values are at V_{CC} = 5V, T_{amb} = 25°C.
- Not more than one output should be shorted at a time. For testing I_{OS}, the use of high-speed test apparatus and/or sample-and-hold techniques are preferable in order to minimize internal heating and more accurately reflect operational values. Otherwise, prolonged shorting of a high output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter tests, I_{OS} tests should be performed last.
- Measure I_{CC} with the clock input grounded and all outputs open, then with Q and \bar{Q} outputs high in turn.

AC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITION	LIMITS						UNIT	
			T _{amb} = +25°C V _{CC} = +5.0V C _L = 50pF, R _L = 500Ω			T _{amb} = 0°C to +70°C V _{CC} = +5.0V ± 10% C _L = 50pF, R _L = 500Ω		T _{amb} = -40°C to +85°C V _{CC} = +5.0V ± 10% C _L = 50pF, R _L = 500Ω		
			MIN	TYP	MAX	MIN	MAX	MIN		MAX
f _{max}	Maximum clock frequency	Waveform 1	85	100		80		80		ns
t _{PLH} t _{PHL}	Propagation delay CP _n to Q _n or \bar{Q} _n	Waveform 1	2.0 2.0	4.0 4.0	6.0 6.0	2.0 2.0	7.0 7.0	2.0 2.0	7.5 7.0	ns
t _{PLH} t _{PHL}	Propagation delay SD _n , to Q _n or \bar{Q} _n	Waveform 2	2.0 2.0	4.5 4.5	6.5 6.5	2.0 2.0	7.5 7.5	2.0 2.0	8.0 7.5	ns

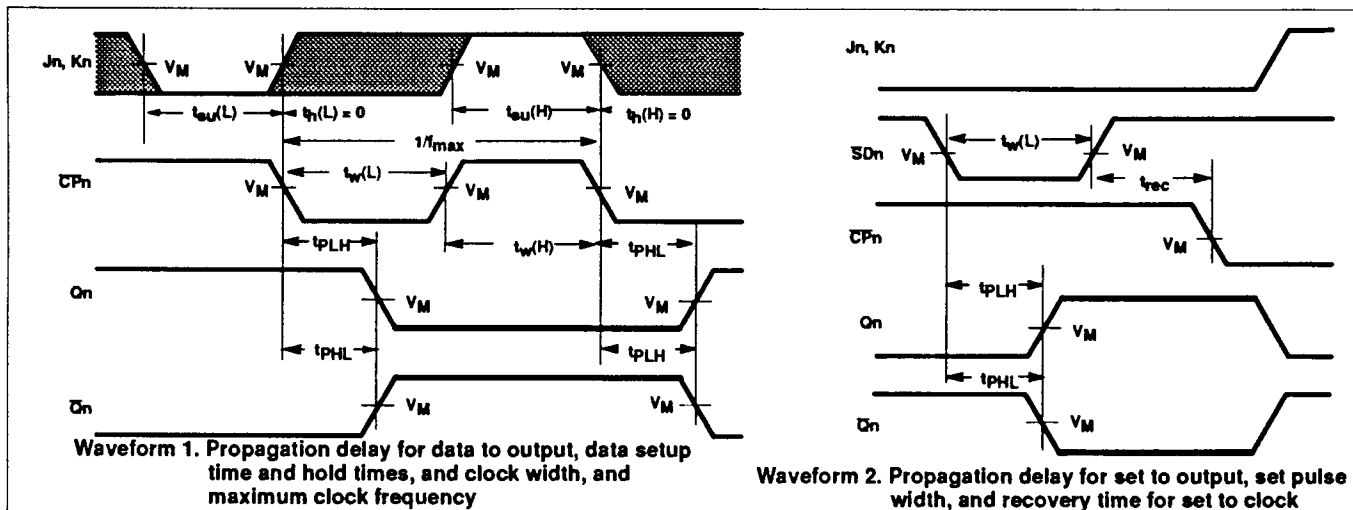
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AC SETUP REQUIREMENTS

SYMBOL	PARAMETER	TEST CONDITION	LIMITS						UNIT		
			$T_{amb} = +25^{\circ}C$ $V_{CC} = +5.0V$ $C_L = 50pF$ $R_L = 500\Omega$			$T_{amb} = 0^{\circ}C \text{ to } +70^{\circ}C$ $V_{CC} = +5.0V \pm 10\%$ $C_L = 50pF$ $R_L = 500\Omega$		$T_{amb} = -40^{\circ}C \text{ to } +85^{\circ}C$ $V_{CC} = +5.0V \pm 10\%$ $C_L = 50pF$ $R_L = 500\Omega$			
			MIN	TYP	MAX	MIN	MAX	MIN		MAX	
$t_{su}(H)$ $t_{su}(L)$	Setup time, high or low Jn, Kn to CPn	Waveform 1	4.0			5.0			5.0		ns
$t_h(H)$ $t_h(L)$	Hold time, high or low Jn, Kn to CPn	Waveform 1	0.0			0.0			0.0		ns
$t_w(H)$ $t_w(L)$	CPn pulse width, high or low	Waveform 1	4.5			5.0			5.0		ns
$t_w(L)$	SDn pulse width, low	Waveform 2	4.5			5.0			5.0		ns
t_{rec}	Recovery time, SDn to CPn	Waveform 2	4.5			5.0			5.0		ns

AC WAVEFORMS



Note to AC waveforms

- For all waveforms, $V_M = 1.5V$.
- The shaded areas indicate when the input is permitted to change for predictable output performance.

TEST CIRCUIT AND WAVEFORMS

