

74AC/ACT11112

Dual J-K Flip-Flop with Set and Reset; Negative Edge-Triggered

Product Specification

ACL Products

FEATURES

- Output capability: ± 24 mA
- CMOS (AC) and TTL (ACT) voltage level inputs
- 50 Ω incident wave switching
- Center-pin V_{CC} and ground configuration to minimize high-speed switching noise
- I_{CC} category: SSI

DESCRIPTION

The 74AC/ACT11112 high-performance CMOS devices combine very high speed and high output drive comparable to the most advanced TTL families.

The 74AC/ACT11112 provides two J-K flip-flops with independent Data, Clock, Set and Reset inputs, and complementary nQ and nQ outputs.

Set (\overline{nS}_D) and Reset (\overline{nR}_D) are asynchronous active-Low inputs and operate independently of the Clock inputs.

Information at the J and K inputs is transferred to the outputs on the High-to-Low transition of the clock pulse. The J and K inputs must be stable one set-up time prior to the High-to-Low clock transition for predictable operation.

GENERAL INFORMATION

SYMBOL	PARAMETER	CONDITIONS $T_A = 25^\circ\text{C}; \text{GND} = 0\text{V};$ $V_{CC} = 5.0\text{V}$	TYPICAL		UNIT
			AC	ACT	
t_{PLH}/t_{PHL}	Propagation delay nCP to nQ or nQ	$C_L = 50\text{pF}$	3.8	4.5	ns
C_{PD}	Power dissipation capacitance per flip-flop ¹	$f = 1\text{MHz}; C_L = 50\text{pF}$	37	39	pF
C_{IN}	Input capacitance	$V_I = 0\text{V}$ or V_{CC}	3.5	3.5	pF
I_{LATCH}	Latch-up current	Per Jedec JC40.2 Standard 17	500	500	mA
f_{MAX}	Maximum clock frequency	$C_L = 50\text{pF}$	175	175	MHz

Note:

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW):

$$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_O) \text{ where:}$$

f_i = input frequency in MHz, C_L = output load capacitance in pF,

f_O = output frequency in MHz, V_{CC} = supply voltage in V,

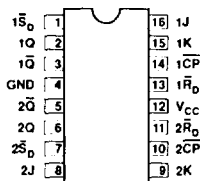
$\sum (C_L \times V_{CC}^2 \times f_O)$ = sum of outputs

ORDERING INFORMATION

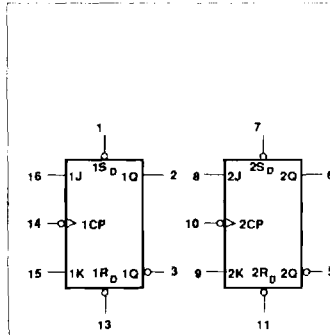
PACKAGES	TEMPERATURE RANGE	ORDER CODE
16-pin plastic DIP (300mil-wide)	-40°C to +85°C	74AC11112N 74ACT11112N
16-pin plastic SO (150mil-wide)	-40°C to +85°C	74AC11112D 74ACT11112D

PIN CONFIGURATION

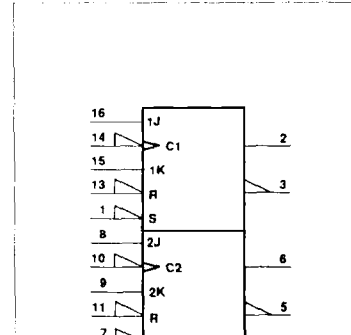
N and D Packages



LOGIC SYMBOL



LOGIC SYMBOL (IEEE/IEC)



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PIN DESCRIPTION

PIN NUMBER	SYMBOL	NAME AND FUNCTION
16, 8	1J - 2J	Data inputs
15, 9	1K - 2K	Data inputs
2, 6	1Q - 2Q	Data outputs
3, 5	$\overline{1Q}$ - $\overline{2Q}$	Data outputs (complements of Q_n outputs)
1, 7	$\overline{1S}_D$ - $\overline{2S}_D$	Set inputs (active Low)
13, 11	$\overline{1R}_D$ - $\overline{2R}_D$	Reset inputs (active Low)
14, 10	$\overline{1CP}$ - $\overline{2CP}$	Clock inputs
4	GND	Ground (0V)
12	V_{CC}	Positive supply voltage

FUNCTION TABLE

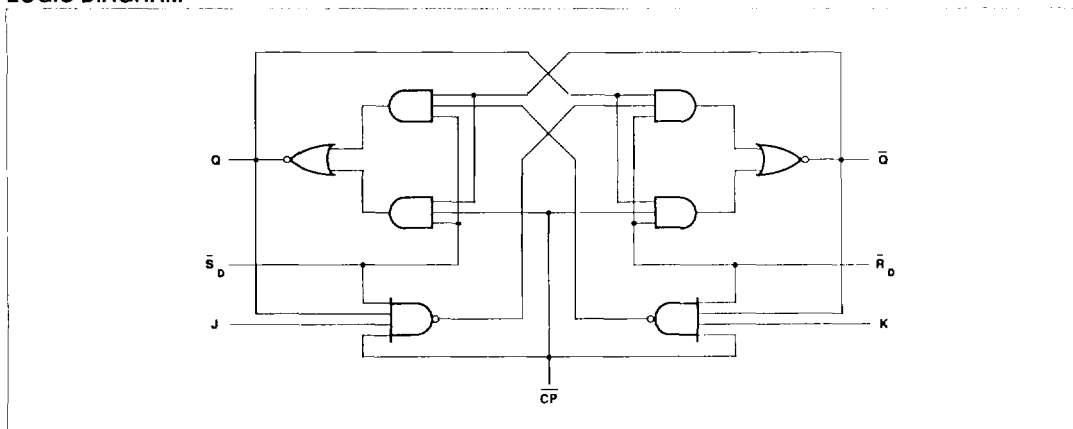
OPERATING MODE	INPUTS					OUTPUTS	
	\overline{S}_D	\overline{R}_D	\overline{CP}	J	K	Q	\overline{Q}
Asynchronous set	L	H	X	X	X	H	L
Asynchronous reset (clear)	H	L	X	X	X	L	H
Undetermined ¹	L	L	X	X	X	H	H
Toggle	H	H	↓	h	h	q	q
Load "0" (reset)	H	H	↓	l	h	L	H
Load "1" (set)	H	H	↓	h	l	H	L
No change – hold	H	H	↓	l	l	q	q
No change – hold	H	H	H	X	X	Q	\overline{Q}

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

NOTE:

1. This configuration is nonstable; that is, it will not persist when either Set or Reset returns to its inactive (High) level.

LOGIC DIAGRAM



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RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	74AC11112			74ACT11112			UNIT
		Min	Nom	Max	Min	Nom	Max	
V_{CC}	DC supply voltage	3.0 ¹	5.0	5.5	4.5	5.0	5.5	V
V_I	Input voltage	0		V_{CC}	0		V_{CC}	V
V_O	Output voltage	0		V_{CC}	0		V_{CC}	V
$\Delta t/\Delta v$	Input transition rise or fall rate	0		10	0		10	ns/V
T_A	Operating free-air temperature	-40		+85	-40		+85	°C

NOTE:

- No electrical or switching characteristics are specified at $V_{CC} < 3V$. Operation between 2V and 3V is not recommended, but within that range, a device output will maintain a previously established logic state.

ABSOLUTE MAXIMUM RATINGS¹

SYMBOL	PARAMETER	TEST CONDITIONS	RATING	UNIT
V_{CC}	DC supply voltage		-0.5 to +7.0	V
I_{IK} or V_I	DC input diode current ²	$V_I < 0$	-20	mA
		$V_I > V_{CC}$	20	
	DC input voltage		-0.5 to $V_{CC} + 0.5$	V
I_{OK} or V_O	DC output diode current ²	$V_O < 0$	-50	mA
		$V_O > V_{CC}$	50	
	DC output voltage		-0.5 to $V_{CC} + 0.5$	V
I_O	DC output source or sink current per output pin	$V_O = 0$ to V_{CC}	±50	mA
I_{CC} or I_{GND}	DC V_{CC} current		±100	mA
	DC ground current		±100	
T_{STG}	Storage temperature		-65 to 150	°C
P_{TOT}	Power dissipation per package Plastic DIP	Above 70°C: derate linearly by 8mW/K	500	mW
	Power dissipation per package	Above 70°C: derate linearly by 6mW/K	400	mW

NOTES:

- Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

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DC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITIONS	V _{CC}	74AC11112				74ACT11112				UNIT
				T _A = +25°C		T _A = -40°C to +85°C		T _A = +25°C		T _A = -40°C to +85°C		
				V	Min	Max	Min	Max	Min	Max	Min	
V _{IH}	High-level input voltage		3.0	2.10		2.10						V
			4.5	3.15		3.15		2.0		2.0		
			5.5	3.85		3.85		2.0		2.0		
V _{IL}	Low-level input voltage		3.0		0.90		0.90					V
			4.5		1.35		1.35		0.8		0.8	
			5.5		1.65		1.65		0.8		0.8	
V _{OH}	High-level output voltage	V _I = V _{IL} or V _{IH} I _{OH} = -50μA	3.0	2.9		2.9						V
			4.5	4.4		4.4		4.4		4.4		
			5.5	5.4		5.4		5.4		5.4		
			5.5	5.4		5.4		5.4		5.4		
		I _{OH} = -4mA	3.0	2.58		2.48						
			4.5	3.94		3.8		3.94		3.8		
			5.5	4.94		4.8		4.94		4.8		
			5.5			3.85				3.85		
V _{OL}	Low-level output voltage	V _I = V _{IL} or V _{IH} I _{OL} = 50μA	3.0		0.1		0.1					V
			4.5		0.1		0.1		0.1		0.1	
			5.5		0.1		0.1		0.1		0.1	
			5.5		0.1		0.1		0.1		0.1	
		I _{OL} = 12mA	3.0		0.36		0.44					
			4.5		0.36		0.44		0.36		0.44	
			5.5		0.36		0.44		0.36		0.44	
			5.5				1.65				1.65	
I _I	Input leakage current	V _I = V _{CC} or GND	5.5		±0.1		±1.0		±0.1		±1.0	μA
I _{CC}	Quiescent supply current	V _I = V _{CC} or GND, I _O = 0	5.5		4.0		40		4.0		40	μA
ΔI _{CC}	Supply current, TTL inputs High ²	One input at 3.4V, other inputs at V _{CC} or GND	5.5						0.9		1.0	mA

NOTES:

- Not more than one output should be tested at a time, and the duration of the test should not exceed 10ms.
- This is the increase in supply current for each input that is at one of the specified TTL voltage levels rather than 0V or V_{CC}.

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AC ELECTRICAL CHARACTERISTICS AT 3.3V $\pm 0.3V$

SYMBOL	PARAMETER	WAVEFORM	74AC11112						UNIT
			$T_A = +25^\circ\text{C}$			$T_A = -40^\circ\text{C to } +85^\circ\text{C}$			
			Min	Typ	Max	Min	Max		
f_{MAX}	Maximum clock frequency	1	100	150		100		MHz	
t_{PLH} t_{PHL}	Propagation delay $n\overline{\text{CP}}$ to $n\text{Q}$, $n\overline{\text{Q}}$	1	1.5	5.4	7.1	1.5	7.6	ns	
t_{PLH} t_{PHL}	Propagation delay $n\overline{\text{S}}_D$, $n\overline{\text{R}}_D$ to $n\text{Q}$, $n\overline{\text{Q}}$	2	1.5	4.9	6.7	1.5	7.3	ns	
t_{S}	Setup time, High or Low $n\text{J}$ or $n\text{K}$ to $n\overline{\text{CP}}$	1	5.0			5.0		ns	
t_{H}	Hold time, High or Low $n\overline{\text{CP}}$ to $n\text{J}$ or $n\text{K}$	1	0.5			0.5		ns	
t_{W}	Clock pulse width High or Low	1	5.0			5.0		ns	
t_{W}	$n\overline{\text{S}}_D$ or $n\overline{\text{R}}_D$ pulse width, Low	2	4.0			4.0		ns	
t_{REC}	Recovery time $n\overline{\text{S}}_D$ or $n\overline{\text{R}}_D$ to $n\overline{\text{CP}}$	3	2.5			2.5		ns	

AC ELECTRICAL CHARACTERISTICS AT 5.0V $\pm 0.5V$

SYMBOL	PARAMETER	WAVEFORM	74AC11112						UNIT
			$T_A = +25^\circ\text{C}$			$T_A = -40^\circ\text{C to } +85^\circ\text{C}$			
			Min	Typ	Max	Min	Max		
f_{MAX}	Maximum clock frequency	1	125	175		125		MHz	
t_{PLH} t_{PHL}	Propagation delay $n\overline{\text{CP}}$ to $n\text{Q}$, $n\overline{\text{Q}}$	1	1.5	3.4	5.1	1.5	5.6	ns	
t_{PLH} t_{PHL}	Propagation delay $n\overline{\text{S}}_D$, $n\overline{\text{R}}_D$ to $n\text{Q}$, $n\overline{\text{Q}}$	2	1.5	3.3	5.1	1.5	5.4	ns	
t_{S}	Setup time, High or Low $n\text{J}$ or $n\text{K}$ to $n\overline{\text{CP}}$	1	3.5			3.5		ns	
t_{H}	Hold time, High or Low $n\overline{\text{CP}}$ to $n\text{J}$ or $n\text{K}$	1	1.0			1.0		ns	
t_{W}	Clock pulse width High or Low	1	4.0			4.0		ns	
t_{W}	$n\overline{\text{S}}_D$ or $n\overline{\text{R}}_D$ pulse width, Low	2	3.0			3.0		ns	
t_{REC}	Recovery time $n\overline{\text{S}}_D$ or $n\overline{\text{R}}_D$ to $n\overline{\text{CP}}$	3	2.0			2.0		ns	

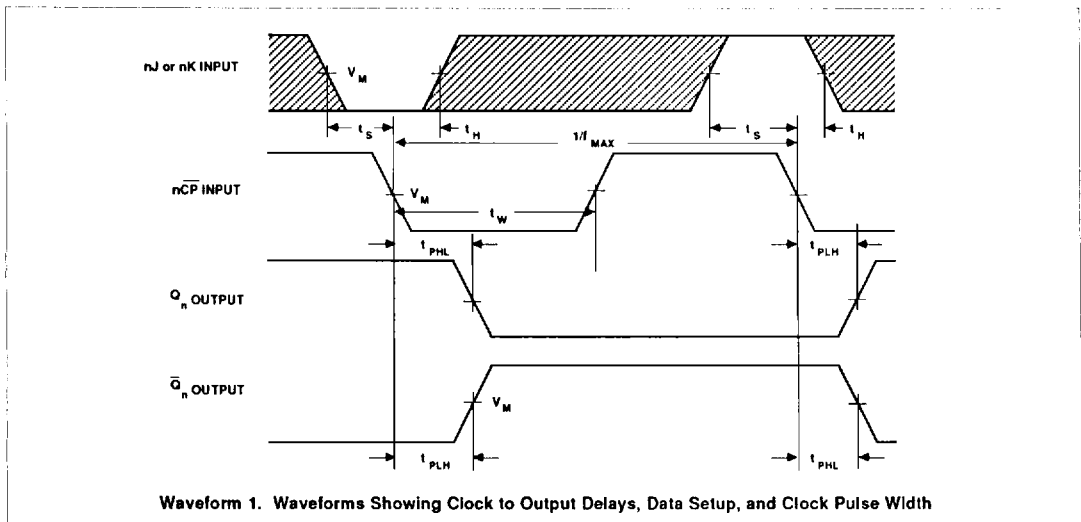
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AC ELECTRICAL CHARACTERISTICS AT 5.0V $\pm 0.5V$

SYMBOL	PARAMETER	WAVEFORM	74ACT11112					UNIT
			$T_A = +25^\circ\text{C}$			$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		
			Min	Typ	Max	Min	Max	
f_{MAX}	Maximum clock frequency	1	125	175	7.0	125		MHz
t_{PLH} t_{PHL}	Propagation delay $n\overline{\text{CP}}$ to $n\text{Q}$, $n\overline{\text{Q}}$	1	1.5	4.2	7.4	1.5	7.7	ns
t_{PLH} t_{PHL}	Propagation delay $n\overline{\text{S}}_D$, $n\overline{\text{R}}_D$ to $n\text{Q}$, $n\overline{\text{Q}}$	2	1.5	3.6	7.4	1.5	8.0	ns
t_{S}	Setup time, High or Low $n\text{J}$ or $n\text{K}$ to $n\overline{\text{CP}}$	1	3.5			3.5		ns
t_{H}	Hold time, High or Low $n\overline{\text{CP}}$ to $n\text{J}$ or $n\text{K}$	1	1.5			1.5		ns
t_{W}	Clock pulse width High or Low	1	4.0			4.0		ns
t_{W}	$n\overline{\text{S}}_D$ or $n\overline{\text{R}}_D$ pulse width, Low	2	4.0			4.0		ns
t_{REC}	Recovery time $n\overline{\text{S}}_D$ or $n\overline{\text{R}}_D$ to $n\overline{\text{CP}}$	3	2.0			2.0		ns

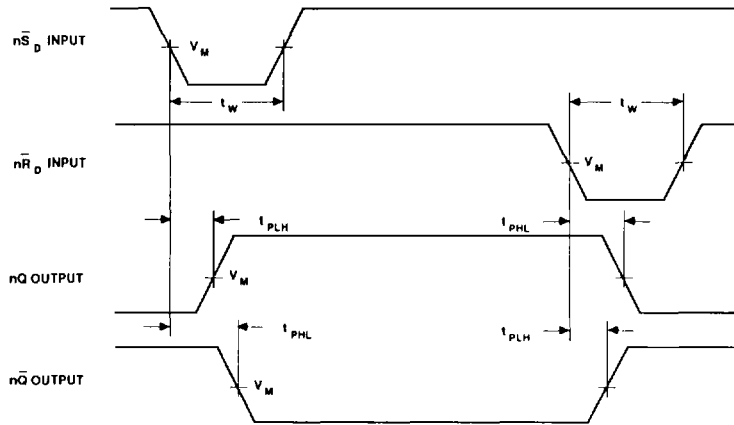
AC WAVEFORMS



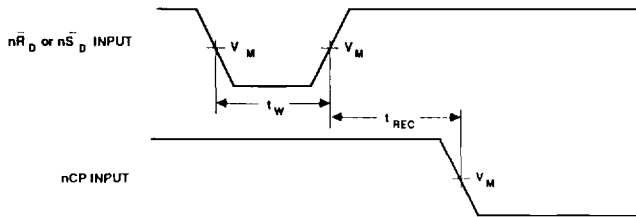
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AC WAVEFORMS (Continued)



Waveform 2. Waveforms Showing Set and Reset to Output Delays, Set and Reset Pulse Widths



Waveform 3. Waveforms Showing Recovery Time

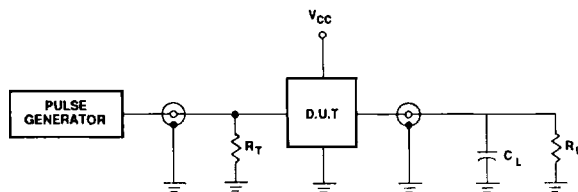
WAVEFORM CONDITIONS

	INPUTS	OUTPUTS
AC	$V_{IN} = \text{GND to } V_{CC}$ $V_M = 50\% V_{CC}$	$V_{OUT} = V_{OL} \text{ to } V_{OH}$
ACT	$V_{IN} = \text{GND to } 3.0V$ $V_M = 1.5V$	$V_M = 50\% V_{CC}$

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TEST CIRCUIT



Test Circuit

DEFINITIONS

C_L = Load capacitance, 50pF; includes jig and probe capacitance

R_L = Load resistor, 500 Ω

R_T = Termination resistance should be equal to Z_{OUT} of pulse generators

Input pulses: PRR \leq 10MHz

$t_r = t_f = 3ns$