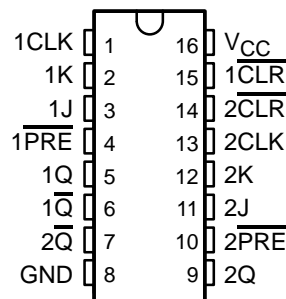


CD54AC112, CD74AC112 DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOPS WITH CLEAR AND PRESET

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- **AC Types Feature 1.5-V to 5.5-V Operation and Balanced Noise Immunity at 30% of the Supply Voltage**
- **Speed of Bipolar F, AS, and S, With Significantly Reduced Power Consumption**
- **Balanced Propagation Delays**
- **± 24 -mA Output Drive Current**
– Fanout to 15 F Devices
- **SCR-Latchup-Resistant CMOS Process and Circuit Design**
- **Exceeds 2-kV ESD Protection Per MIL-STD-883, Method 3015**

CD54AC112 . . . F PACKAGE
CD74AC112 . . . E OR M PACKAGE
(TOP VIEW)



description/ordering information

The 'AC112 devices contain two independent J-K negative-edge-triggered flip-flops. A low level at the preset ($\overline{\text{PRE}}$) or clear ($\overline{\text{CLR}}$) inputs sets or resets the outputs, regardless of the levels of the other inputs. When $\overline{\text{PRE}}$ and $\overline{\text{CLR}}$ are inactive (high), data at the J and K inputs meeting the setup-time requirements is transferred to the outputs on the negative-going edge of the clock pulse (CLK). Clock triggering occurs at a voltage level and is not directly related to the fall 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.

ORDERING INFORMATION

TA	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–55°C to 125°C	PDIP – E	Tube	CD74AC112E	CD74AC112E
	SOIC – M	Tube	CD74AC112M	AC112M
		Tape and reel	CD74AC112M96	
	CDIP – F	Tube	CD54AC112F3A	CD54AC112F3A

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

CD54AC112, CD74AC112
DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOPS
WITH CLEAR AND PRESET

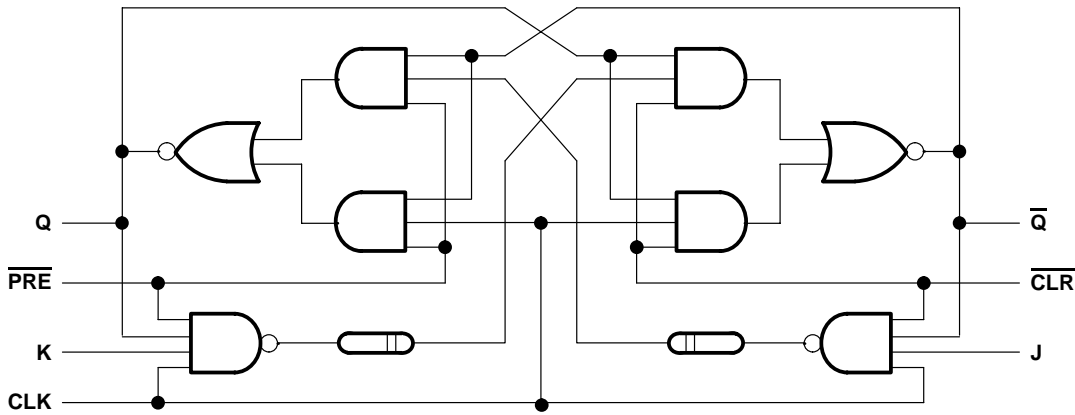
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FUNCTION TABLE
 (each flip-flop)

INPUTS					OUTPUTS	
$\overline{\text{PRE}}$	$\overline{\text{CLR}}$	CLK	J	K	Q	$\overline{\text{Q}}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H [†]	H [†]
H	H	↓	L	L	Q ₀	$\overline{\text{Q}}_0$
H	H	↓	H	L	H	L
H	H	↓	L	H	L	H
H	H	↓	H	H	Toggle	Toggle
H	H	H	X	X	Q ₀	$\overline{\text{Q}}_0$

[†] Output states are unpredictable if $\overline{\text{PRE}}$ and $\overline{\text{CLR}}$ go high simultaneously after both being low at the same time.

logic diagram (positive logic)



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

Supply voltage range, V_{CC}	-0.5 V to 6 V
Input clamp current, I_{IK} ($V_I < 0$ V or $V_I > V_{CC}$) (see Note 1)	± 20 mA
Output clamp current, I_{OK} ($V_O < 0$ V or $V_O > V_{CC}$) (see Note 1)	± 50 mA
Continuous output current, I_O ($V_O > 0$ V or $V_O < V_{CC}$)	± 50 mA
Continuous current through V_{CC} or GND	± 100 mA
Package thermal impedance, θ_{JA} (see Note 2): E package	67°C/W
M package	73°C/W
Storage temperature range, T_{stg}	-65°C to 150°C

[†] Stresses beyond those listed under “absolute maximum ratings” 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.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
 2. The package thermal impedance is calculated in accordance with JESD 51-7.



CD54AC112, CD74AC112 DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOPS WITH CLEAR AND PRESET

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recommended operating conditions (see Note 3)

		T _A = 25°C		-55°C to 125°C		-40°C to 85°C		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
V _{CC}	Supply voltage	1.5	5.5	1.5	5.5	1.5	5.5	V
V _{IH}	High-level input voltage	V _{CC} = 1.5 V		1.2		1.2		V
		V _{CC} = 3 V		2.1		2.1		
		V _{CC} = 5.5 V		3.85		3.85		
V _{IL}	Low-level input voltage	V _{CC} = 1.5 V		0.3		0.3		V
		V _{CC} = 3 V		0.9		0.9		
		V _{CC} = 5.5 V		1.65		1.65		
V _I	Input voltage	0	V _{CC}	0	V _{CC}	0	V _{CC}	V
V _O	Output voltage	0	V _{CC}	0	V _{CC}	0	V _{CC}	V
I _{OH}	High-level output current	V _{CC} = 4.5 V to 5.5 V		-24		-24		mA
I _{OL}	Low-level output current	V _{CC} = 4.5 V to 5.5 V		24		24		mA
Δt/Δv	Input transition rise or fall rate	V _{CC} = 1.5 V to 3 V		50		50		ns/V
		V _{CC} = 3.6 V to 5.5 V		20		20		

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	V _{CC}	T _A = 25°C		-55°C to 125°C		-40°C to 85°C		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
V _{OH}	V _I = V _{IH} or V _{IL}	I _{OH} = -50 μA	1.5 V	1.4	1.4	1.4	V		
			3 V	2.9	2.9	2.9			
			4.5 V	4.4	4.4	4.4			
		I _{OH} = -4 mA	3 V	2.58	2.4	2.48			
		I _{OH} = -24 mA	4.5 V	3.94	3.7	3.8			
		I _{OH} = -50 mA [†]	5.5 V		3.85				
V _{OL}	V _I = V _{IH} or V _{IL}	I _{OL} = 50 μA	1.5 V	0.1	0.1	0.1	V		
			3 V	0.1	0.1	0.1			
			4.5 V	0.1	0.1	0.1			
		I _{OL} = 12 mA	3 V	0.36	0.5	0.44			
		I _{OL} = 24 mA	4.5 V	0.36	0.5	0.44			
		I _{OL} = 50 mA [†]	5.5 V		1.65				
I _I	V _I = V _{CC} or GND	5.5 V	±0.1	±1	±1	μA			
I _{CC}	V _I = V _{CC} or GND, I _O = 0	5.5 V	4	80	40	μA			
C _i			10	10	10	pF			

[†] Test one output at a time, not exceeding 1-second duration. Measurement is made by forcing indicated current and measuring voltage to minimize power dissipation. Test verifies a minimum 50-Ω transmission-line drive capability at 85°C and 75-Ω transmission-line drive capability at 125°C.



CD54AC112, CD74AC112
DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOPS
WITH CLEAR AND PRESET

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timing requirements over recommended operating free-air temperature range, $V_{CC} = 1.5\text{ V}$ (unless otherwise noted)

		-55°C to 125°C		-40°C to 85°C		UNIT
		MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency	8		9		MHz
t_w	Pulse duration	CLK high or low		63	55	ns
		$\overline{\text{CLR}}$ or $\overline{\text{PRE}}$ low		56	49	
t_{su}	Setup time, before CLK↓	J or K		50	44	ns
t_h	Hold time, after CLK↓	J or K		0	0	ns
t_{rec}	Recovery time, before CLK↓	$\overline{\text{CLR}}\uparrow$ or $\overline{\text{PRE}}\uparrow$		31	27	ns

timing requirements over recommended operating free-air temperature range, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted)

		-55°C to 125°C		-40°C to 85°C		UNIT
		MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency	71		81		MHz
t_w	Pulse duration	CLK high or low		7	6	ns
		$\overline{\text{CLR}}$ or $\overline{\text{PRE}}$ low		6.3	5.5	
t_{su}	Setup time, before CLK↓	J or K		5.6	4.9	ns
t_h	Hold time, after CLK↓	J or K		0	0	ns
t_{rec}	Recovery time, before CLK↓	$\overline{\text{CLR}}\uparrow$ or $\overline{\text{PRE}}\uparrow$		3.5	3.1	ns

timing requirements over recommended operating free-air temperature range, $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted)

		-55°C to 125°C		-40°C to 85°C		UNIT
		MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency	100		114		MHz
t_w	Pulse duration	CLK high or low		5	4.4	ns
		$\overline{\text{CLR}}$ or $\overline{\text{PRE}}$ low		4.5	3.9	
t_{su}	Setup time, before CLK↓	J or K		4	3.5	ns
t_h	Hold time, after CLK↓	J or K		0	0	ns
t_{rec}	Recovery time, before CLK↓	$\overline{\text{CLR}}\uparrow$ or $\overline{\text{PRE}}\uparrow$		2.5	2.2	ns



CD54AC112, CD74AC112
DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOPS
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switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 1.5\text{ V}$, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	–55°C to 125°C		–40°C to 85°C		UNIT
			MIN	MAX	MIN	MAX	
f_{max}			8		9		MHz
t_{PLH}	CLK	Q or \bar{Q}		129		117	ns
	$\overline{\text{CLR}}$ or $\overline{\text{PRE}}$			153		139	
t_{PHL}	CLK	Q or \bar{Q}		129		117	ns
	$\overline{\text{CLR}}$ or $\overline{\text{PRE}}$			153		139	

switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	–55°C to 125°C		–40°C to 85°C		UNIT
			MIN	MAX	MIN	MAX	
f_{max}			71		81		MHz
t_{PLH}	CLK	Q or \bar{Q}	3.6	14.4	3.7	13.1	ns
	$\overline{\text{CLR}}$ or $\overline{\text{PRE}}$		4.3	17.1	4.4	15.5	
t_{PHL}	CLK	Q or \bar{Q}	3.6	14.4	3.7	13.1	ns
	$\overline{\text{CLR}}$ or $\overline{\text{PRE}}$		4.3	17.1	4.4	15.5	

switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	–55°C to 125°C		–40°C to 85°C		UNIT
			MIN	MAX	MIN	MAX	
f_{max}			100		114		MHz
t_{PLH}	CLK	Q or \bar{Q}	2.6	10.3	2.7	9.4	ns
	$\overline{\text{CLR}}$ or $\overline{\text{PRE}}$		3.1	12.2	3.2	11.1	
t_{PHL}	CLK	Q or \bar{Q}	2.6	10.3	2.7	9.4	ns
	$\overline{\text{CLR}}$ or $\overline{\text{PRE}}$		3.1	12.2	3.2	11.1	

operating characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER		TYP	UNIT
C_{pd}	Power dissipation capacitance	56	pF

CD54AC112, CD74AC112 DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOPS WITH CLEAR AND PRESET

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PARAMETER MEASUREMENT INFORMATION



† When $V_{CC} = 1.5\text{ V}$, $R1 = R2 = 1\text{ k}\Omega$

LOAD CIRCUIT

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	$2 \times V_{CC}$
t_{PHZ}/t_{PZH}	GND



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
RECOVERY TIME



VOLTAGE WAVEFORMS
SETUP AND HOLD AND INPUT RISE AND FALL TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES



VOLTAGE WAVEFORMS
OUTPUT ENABLE AND DISABLE TIMES

- NOTES:
- C_L includes probe and test-fixture capacitance.
 - Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
 - All input pulses are supplied by generators having the following characteristics: $PRR \leq 1\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r = 3\text{ ns}$, $t_f = 3\text{ ns}$. Phase relationships between waveforms are arbitrary.
 - For clock inputs, f_{max} is measured with the input duty cycle at 50%.
 - The outputs are measured one at a time with one input transition per measurement.
 - t_{PLH} and t_{PHL} are the same as t_{pd} .
 - t_{PZL} and t_{PZH} are the same as t_{en} .
 - t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
CD54AC112F3A	Active	Production	CDIP (J) 16	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD54AC112F3A
CD54AC112F3A.A	Active	Production	CDIP (J) 16	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD54AC112F3A
CD74AC112E	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74AC112E
CD74AC112E.A	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74AC112E
CD74AC112M	Obsolete	Production	SOIC (D) 16	-	-	Call TI	Call TI	-55 to 125	AC112M
CD74AC112M96	Active	Production	SOIC (D) 16	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	AC112M
CD74AC112M96.A	Active	Production	SOIC (D) 16	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	AC112M

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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OTHER QUALIFIED VERSIONS OF CD54AC112, CD74AC112 :

- Catalog : [CD74AC112](#)
- Military : [CD54AC112](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD74AC112M96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD74AC112M96	SOIC	D	16	2500	353.0	353.0	32.0

TUBE


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
CD74AC112E	N	PDIP	16	25	506	13.97	11230	4.32
CD74AC112E	N	PDIP	16	25	506	13.97	11230	4.32
CD74AC112E.A	N	PDIP	16	25	506	13.97	11230	4.32
CD74AC112E.A	N	PDIP	16	25	506	13.97	11230	4.32

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package is hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - The 20 pin end lead shoulder width is a vendor option, either half or full width.

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