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74VHC112 Dual J-K Flip-Flops with Preset and Clear

Features

- High speed: $f_{MAX} = 200\text{MHz}$ (Typ.) at $V_{CC} = 5.0\text{V}$
- Low power dissipation: $I_{CC} = 2\mu\text{A}$ (Max.) at $T_A = 25^\circ\text{C}$
- High noise immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (Min.)
- Power down protection is provided on all inputs
- Pin and function compatible with 74HC112

General Description

The VHC112 is an advanced high speed CMOS device fabricated with silicon gate CMOS technology. It achieves the high-speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

The VHC112 contains two independent, high-speed JK flip-flops with Direct Set and Clear inputs. Synchronous state changes are initiated by the falling edge of the clock and is not directly related to transition time. The J and K inputs can change when the clock is in either state without affecting the flip-flop, provided that they are in the desired state during the recommended setup and hold times relative to the falling edge of the clock. The LOW signal on PR or CLR prevents clocking and forces Q and \bar{Q} HIGH, respectively. Simultaneous LOW signals on PR and CLR force both Q and \bar{Q} HIGH.

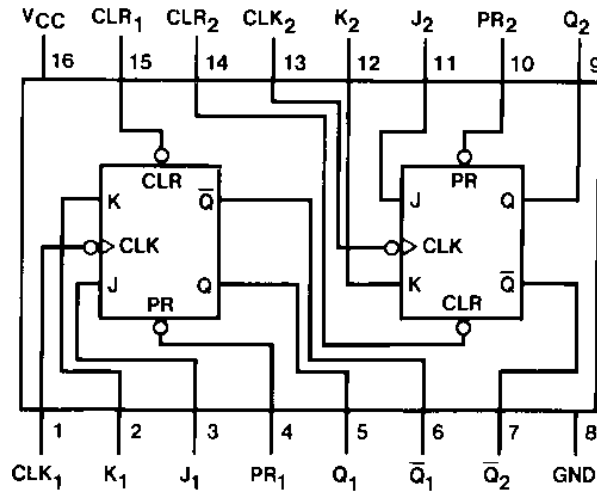
An input protection circuit ensures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery backup. This circuit prevents device destruction due to mismatched supply and input voltages.

Ordering Information

Order Number	Package Number	Package Description
74VHC112M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHC112SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74VHC112MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering number.

Connection Diagram



Truth Table

Inputs					Outputs	
PR	CLR	\overline{CP}	J	K	Q	\overline{Q}
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H	H
H	H	\sim	h	h	$\overline{Q_0}$	Q_0
H	H	\sim	l	h	L	H
H	H	\sim	h	l	H	L
H	H	\sim	l	l	Q_0	$\overline{Q_0}$

H (h) = HIGH Voltage Level

L (l) = LOW Voltage Level

X = Immaterial

\sim = HIGH-to-LOW Clock Transition

Q_0 ($\overline{Q_0}$) = Before HIGH-to-LOW Transition of Clock

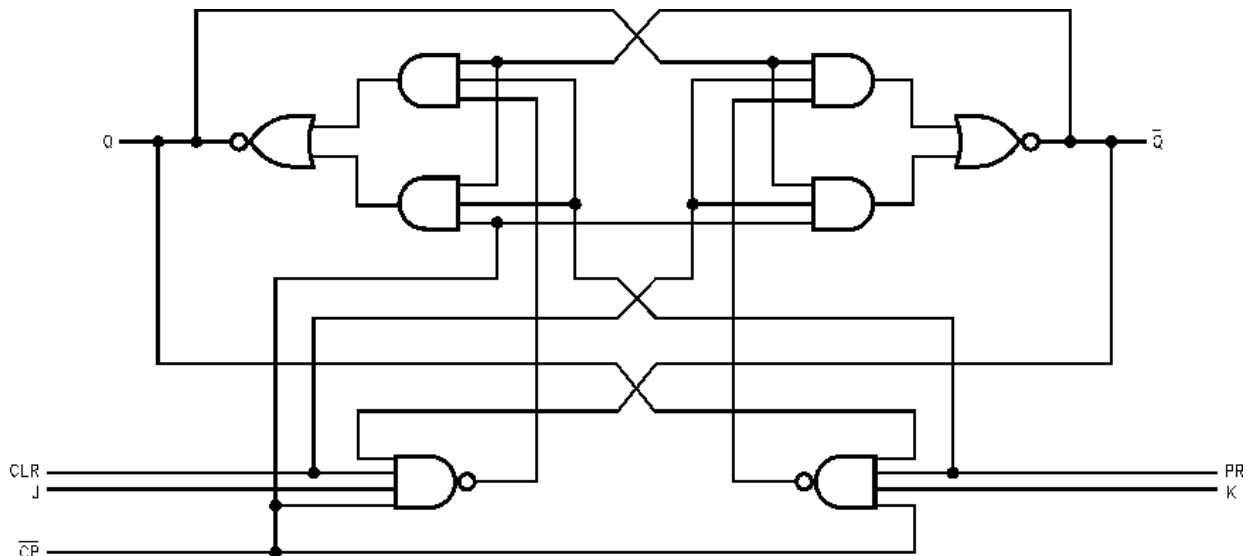
Lower case letters indicate the state of the referenced input or output one setup time prior to the HIGH-to-LOW clock transition.

Pin Description

Pin Names	Description
J ₁ , J ₂ , K ₁ , K ₂	Data Inputs
CLK ₁ , CLK ₂	Clock Pulse Inputs (Active Falling Edge)
CLR ₁ , CLR ₂	Direct Clear Inputs (Active LOW)
PR ₁ , PR ₂	Direct Preset Inputs (Active LOW)
Q ₁ , Q ₂ , $\overline{Q_1}$, $\overline{Q_2}$	Outputs

Logic Diagram

(One Half Shown)



Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Rating
V_{CC}	Supply Voltage	-0.5V to +7.0V
V_{IN}	DC Input Voltage	-0.5V to +7.0V
V_{OUT}	DC Output Voltage	-0.5V to $V_{CC} + 0.5V$
I_{IK}	Input Diode Current	-20mA
I_{OK}	Output Diode Current	$\pm 20mA$
I_{OUT}	DC Output Current	$\pm 25mA$
I_{CC}	DC V_{CC} / GND Current	$\pm 50mA$
T_{STG}	Storage Temperature	-65°C to +150°C
T_L	Lead Temperature (Soldering, 10 seconds)	260°C

Recommended Operating Conditions⁽¹⁾

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Rating
V_{CC}	Supply Voltage	2.0V to +5.5V
V_{IN}	Input Voltage	0V to +5.5V
V_{OUT}	Output Voltage	0V to V_{CC}
T_{OPR}	Operating Temperature	-40°C to +85°C
t_r, t_f	Input Rise and Fall Time, $V_{CC} = 3.3V \pm 0.3V$ $V_{CC} = 5.0V \pm 0.5V$	0ns/V ~ 100ns/V 0ns/V ~ 20ns/V

Note:

1. Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

Symbol	Parameter	V _{CC} (V)	Conditions	T _A = 25°C			T _A = -40°C to +85°C		Units	
				Min.	Typ.	Max.	Min.	Max.		
V _{IH}	HIGH Level Input Voltage	2.0		1.50			1.50		V	
		3.0–5.5		0.7 × V _{CC}			0.7 × V _{CC}			
V _{IL}	LOW Level Input Voltage	2.0				0.50		0.50	V	
		3.0–5.5				0.3 × V _{CC}		0.3 × V _{CC}		
V _{OH}	HIGH Level Output Voltage	2.0	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -50μA	1.9	2.0		1.9		V
		3.0			2.9	3.0		2.9		
		4.5			4.4	4.5		4.4		
		3.0		I _{OH} = -4mA	2.58			2.48		
		4.5		I _{OH} = -8mA	3.94			3.80		
V _{OL}	LOW Level Output Voltage	2.0	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 50μA		0.0	0.1		0.1	V
		3.0				0.0	0.1		0.1	
		4.5				0.0	0.1		0.1	
		3.0		I _{OL} = 4mA			0.36		0.44	
		4.5		I _{OL} = 8mA			0.36		0.44	
I _{IN}	Input Leakage Current	0–5.5	V _{IN} = 5.5V or GND			±0.1		±1.0	μA	
I _{CC}	Quiescent Supply Current	5.5	V _{IN} = V _{CC} or GND			2.0		20.0	μA	

AC Electrical Characteristics

Symbol	Parameter	V _{CC} (V)	Conditions	T _A = 25°C			T _A = -40°C to +85°C		Units
				Min.	Typ.	Max.	Min.	Max.	
f _{MAX}	Maximum Clock Frequency	3.3 ± 0.3	C _L = 15pF	110	150		100		MHz
			C _L = 50pF	90	120		80		
		5.0 ± 0.5	C _L = 15pF	150	200		135		MHz
			C _L = 50pF	120	185		110		
t _{PLH} , t _{PHL}	Propagation Delay Time (CP to Q _n or \bar{Q}_n)	3.3 ± 0.3	C _L = 15pF		8.5	11.0	1.0	13.4	ns
			C _L = 50pF		10.0	15.0	1.0	16.5	
		5.0 ± 0.5	C _L = 15pF		5.1	7.3	1.0	8.8	ns
			C _L = 50pF		6.3	10.5	1.0	12.0	
t _{PLH} , t _{PHL}	Propagation Delay Time (PR or CLR to Q _n or \bar{Q}_n)	3.3 ± 0.3	C _L = 15pF		6.7	10.2	1.0	11.7	ns
			C _L = 50pF		9.7	13.5	1.0	15.0	
		5.0 ± 0.5	C _L = 15pF		4.6	6.7	1.0	8.0	ns
			C _L = 50pF		6.4	9.5	1.0	11.0	
C _{IN}	Input Capacitance		V _{CC} = Open		4	10		10	pF
C _{PD}	Power Dissipation Capacitance		(2)		18				pF

Note:

2. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained from the equation:
 $I_{CC}(\text{opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 4$ (per F/F), and the total C_{PD} when n pcs of the Flip-Flop operate can be calculated by the following equation: $C_{PD}(\text{total}) = 30 + 14 \cdot n$

AC Operating Requirements

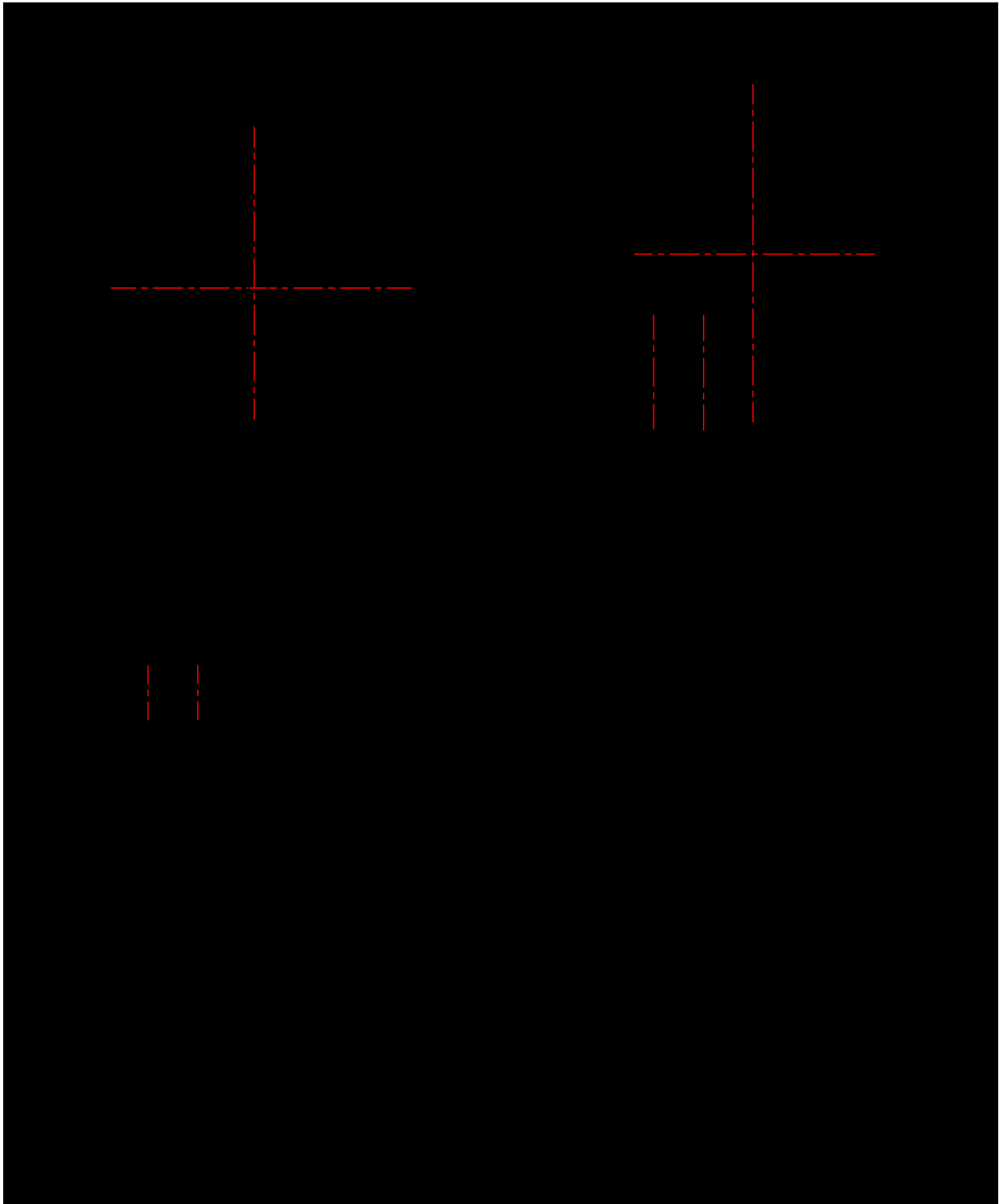
Symbol	Parameter	V _{CC} (V) ⁽³⁾	T _A = 25°C		T _A = -40°C to +85°C		Units
			Typ.	Guaranteed Minimum			
t _W	Minimum Pulse Width (CP or CLR or PR)	3.3		5.0	5.0	ns	
		5.0		5.0	5.0		
t _S	Minimum Setup Time (J _n or K _n to CP _n)	3.3		5.0	5.0	ns	
		5.0		4.0	4.0		
t _H	Minimum Hold Time (J _n or K _n to CP _n)	3.3		1.0	1.0	ns	
		5.0		1.0	1.0		
t _{REC}	Minimum Recovery Time (CLR or PR to CP)	3.3		6.0	6.0	ns	
		5.0		5.0	5.0		

Note:

3. V_{CC} is 3.3 ± 0.3V or 5.0 ± 0.5V.

Physical Dimensions (Continued)

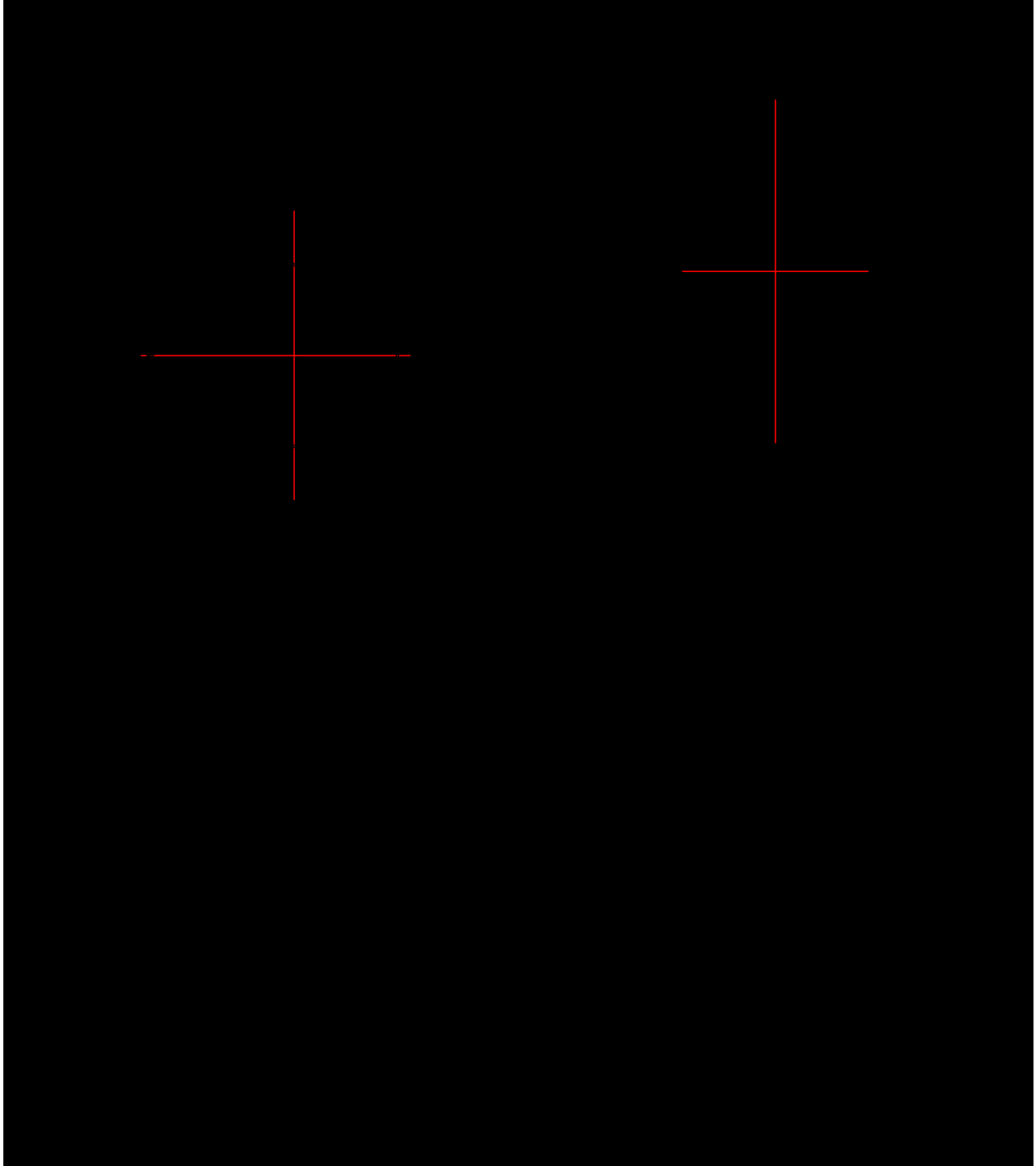
Dimensions are in millimeters unless otherwise noted.



**Figure 2. 16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
Package Number M16D**


Physical Dimensions (Continued)

Dimensions are in millimeters unless otherwise noted.



**Figure 3. 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
Package Number MTC16**



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