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August 1986  
 Revised March 2000

## DM74LS112A

### Dual Negative-Edge-Triggered Master-Slave J-K Flip-Flop with Preset, Clear, and Complementary Outputs

#### General Description

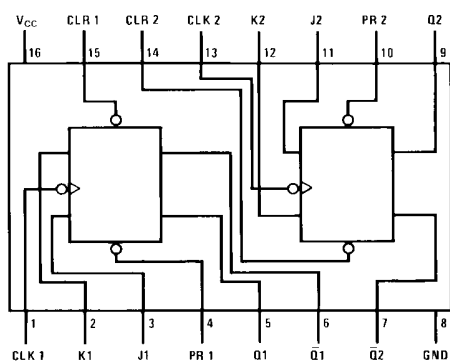
This device contains two independent negative-edge-triggered J-K flip-flops with complementary outputs. The J and K data is processed by the flip-flop on the falling edge of the clock pulse. The clock triggering occurs at a voltage level and is not directly related to the transition time of the falling edge of the clock pulse. Data on the J and K inputs may be changed while the clock is HIGH or LOW without affecting the outputs as long as the setup and hold times are not violated. A low logic level on the preset or clear inputs will set or reset the outputs regardless of the logic levels of the other inputs.

#### Ordering Code:

Order Number	Package Number	Package Description
DM74KS112AM	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow
DM74LS112AN	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

#### Connection Diagram



#### Function Table

Inputs					Outputs	
PR	CLR	CLK	J	K	Q	Q-bar
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H (Note 1)	H (Note 1)
H	H	↓	L	L	Q <sub>0</sub>	Q <sub>0</sub> -bar
H	H	↓	H	L	H	L
H	H	↓	L	H	L	H
H	H	↓	H	H	Toggle	
H	H	H	X	X	Q <sub>0</sub>	Q <sub>0</sub> -bar

H = HIGH Logic Level  
 L = LOW Logic Level  
 X = Either LOW or HIGH Logic Level  
 ↓ = Negative Going Edge of Pulse  
 Q<sub>0</sub> = The output logic level before the indicated input conditions were established.  
 Toggle = Each output changes to the complement of its previous level on each falling edge of the clock pulse.  
**Note 1:** This configuration is nonstable; that is, it will not persist when preset and/or clear inputs return to their inactive (HIGH) level.

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### Absolute Maximum Ratings (Note 2)

Supply Voltage	7V
Input Voltage	7V
Operating Free Air Temperature Range	0°C to +70°C
Storage Temperature Range	-65°C to +150°C

**Note 2:** The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

### Recommended Operating Conditions

Symbol	Parameter	Min	Nom	Max	Units
V <sub>CC</sub>	Supply Voltage	4.75	5	5.25	V
V <sub>IH</sub>	HIGH Level Input Voltage	2			V
V <sub>IL</sub>	LOW Level Input Voltage			0.8	V
I <sub>OH</sub>	HIGH Level Output Current			-0.4	mA
I <sub>OL</sub>	LOW Level Output Current			8	mA
f <sub>CLK</sub>	Clock Frequency (Note 3)	0		30	MHz
f <sub>CLK</sub>	Clock Frequency (Note 5)	0		25	MHz
t <sub>w</sub>	Pulse Width (Note 3)	Clock HIGH	20		ns
		Preset LOW	25		
		Clear LOW	25		
t <sub>w</sub>	Pulse Width (Note 5)	Clock HIGH	25		ns
		Preset LOW	30		
		Clear LOW	30		
t <sub>SU</sub>	Setup Time (Note 3)(Note 4)	20↓			ns
t <sub>SU</sub>	Setup Time (Note 4)(Note 5)	25↓			ns
t <sub>H</sub>	Hold Time (Note 3)(Note 4)	0↓			ns
t <sub>H</sub>	Hold Time (Note 4)(Note 5)	5↓			ns
T <sub>A</sub>	Free Air Operating Temperature	0		70	°C

**Note 3:** C<sub>L</sub> = 15 pF, R<sub>L</sub> = 2 kΩ, T<sub>A</sub> = 25°C and V<sub>CC</sub> = 5V.

**Note 4:** The symbol (↓) indicates the falling edge of the clock pulse is used for reference.

**Note 5:** C<sub>L</sub> = 50 pF, R<sub>L</sub> = 2 kΩ, T<sub>A</sub> = 25°C and V<sub>CC</sub> = 5V.

Electrical Characteristics						
over recommended operating free air temperature range (unless otherwise noted)						
Symbol	Parameter	Conditions	Min	Typ (Note 6)	Max	Units
V <sub>I</sub>	Input Clamp Voltage	V <sub>CC</sub> = Min, I <sub>I</sub> = -18 mA			-1.5	V
V <sub>OH</sub>	HIGH Level Output Voltage	V <sub>CC</sub> = Min, I <sub>OH</sub> = Max V <sub>IL</sub> = Max, V <sub>IH</sub> = Min	2.7	3.4		V
V <sub>OL</sub>	LOW Level Output Voltage	V <sub>CC</sub> = Min, I <sub>OL</sub> = Max V <sub>IL</sub> = Max, V <sub>IH</sub> = Min		0.35	0.5	V
		I <sub>OL</sub> = 4 mA, V <sub>CC</sub> = Min		0.25	0.4	
I <sub>I</sub>	Input Current @ Max Input Voltage	V <sub>CC</sub> = Max, V <sub>I</sub> = 7V	J, K		0.1	mA
			Clear		0.3	
			Preset		0.3	
			Clock		0.4	
I <sub>IH</sub>	HIGH Level Input Current	V <sub>CC</sub> = Max, V <sub>I</sub> = 2.7V	J, K		20	μA
			Clear		60	
			Preset		60	
			Clock		80	
I <sub>IL</sub>	LOW Level Input Current	V <sub>CC</sub> = Max, V <sub>I</sub> = 0.4V	J, K		-0.4	mA
			Clear		-0.8	
			Preset		-0.8	
			Clock		-0.8	
I <sub>OS</sub>	Short Circuit Output Current	V <sub>CC</sub> = Max (Note 7)	-20		-100	mA
I <sub>CC</sub>	Supply Current	V <sub>CC</sub> = Max (Note 8)		4	6	mA

**Note 6:** All typicals are at V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C.

**Note 7:** Not more than one output should be shorted at a time, and the duration should not exceed one second. For devices, with feedback from the outputs, where shorting the outputs to ground may cause the outputs to change logic state an equivalent test may be performed where V<sub>O</sub> = 2.125V with the minimum and maximum limits reduced by one half from their stated values. This is very useful when using automatic test equipment.

**Note 8:** With all outputs OPEN, I<sub>CC</sub> is measured with the Q and  $\bar{Q}$  outputs HIGH in turn. At the time of measurement the clock is grounded.

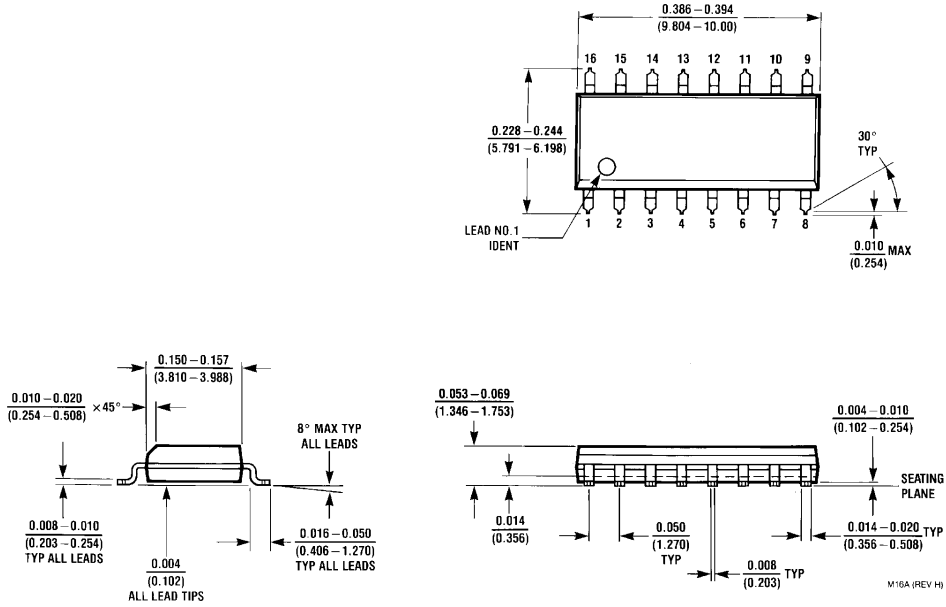
### Switching Characteristics

at V<sub>CC</sub> = 5V and T<sub>A</sub> = 25°C

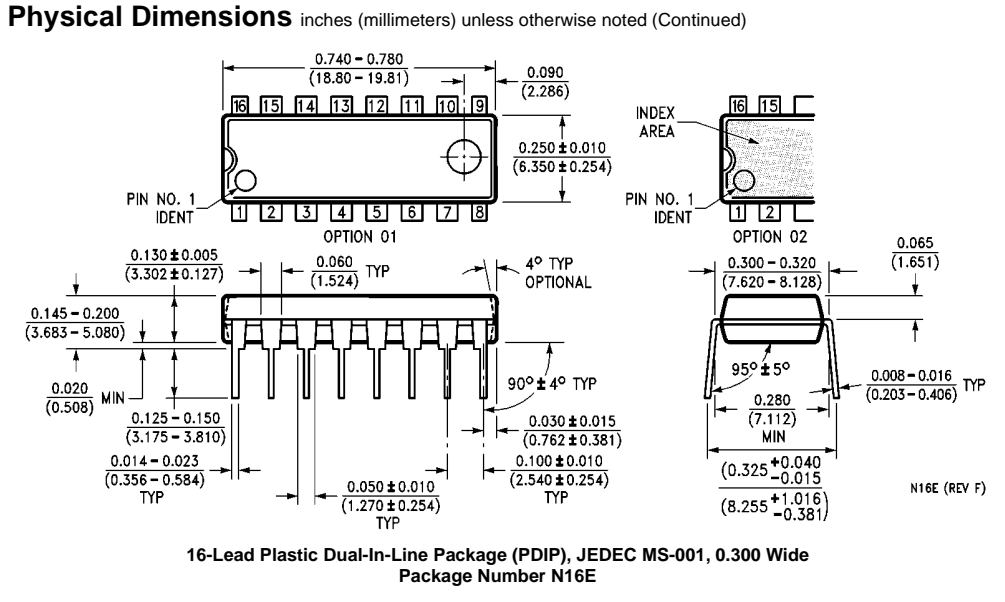
Symbol	Parameter	From (Input) To (Output)	R <sub>L</sub> = 2 kΩ				Units
			C <sub>L</sub> = 15 pF		C <sub>L</sub> = 50 pF		
			Min	Max	Min	Max	
f <sub>MAX</sub>	Maximum Clock Frequency		30		25		MHz
t <sub>PLH</sub>	Propagation Delay Time LOW-to-HIGH Level Output	Preset to Q		20		24	ns
t <sub>PHL</sub>	Propagation Delay Time HIGH-to-LOW Level Output	Preset to $\bar{Q}$		20		28	ns
t <sub>PLH</sub>	Propagation Delay Time LOW-to-HIGH Level Output	Clear to $\bar{Q}$		20		24	ns
t <sub>PHL</sub>	Propagation Delay Time HIGH-to-LOW Level Output	Clear to Q		20		28	ns
t <sub>PLH</sub>	Propagation Delay Time LOW-to-HIGH Level Output	Clock to Q or $\bar{Q}$		20		24	ns
t <sub>PHL</sub>	Propagation Delay Time HIGH-to-LOW Level Output	Clock to Q or $\bar{Q}$		20		28	ns

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**Physical Dimensions** inches (millimeters) unless otherwise noted



16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow Package Number M16A



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