



April 1988
Revised September 2000

74F109

Dual JK Positive Edge-Triggered Flip-Flop

General Description

The F109 consists of two high-speed, completely independent transition clocked JK flip-flops. The clocking operation is independent of rise and fall times of the clock waveform. The JK design allows operation as a D-type flip-flop (refer to F74 data sheet) by connecting the J and K inputs.

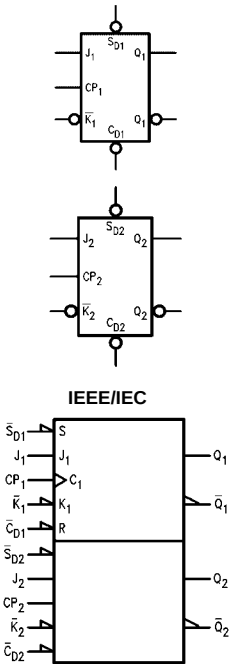
- Asynchronous Inputs:
- LOW input to $\overline{S}_D$ sets Q to HIGH level
 - LOW input to $\overline{C}_D$ sets Q to LOW level
 - Clear and Set are independent of clock
 - Simultaneous LOW on $\overline{C}_D$ and $\overline{S}_D$ makes both Q and $\overline{Q}$ HIGH

Ordering Code:

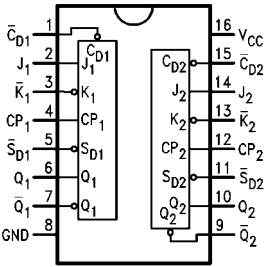
Order Number	Package Number	Package Description
74F109SC	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow
74F109SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74F109PC	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide

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

Logic Symbols



Connection Diagram



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Truth Table

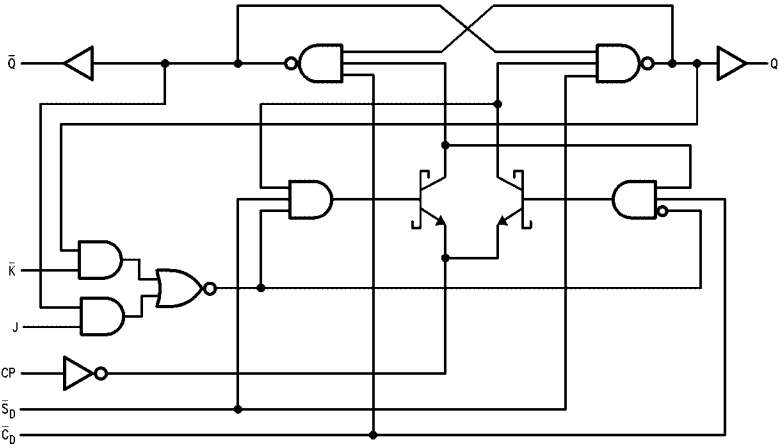
Inputs					Outputs	
$\overline{S_D}$	$\overline{C_D}$	CP	J	$\overline{K}$	Q	$\overline{Q}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H	H
H	H	$\nearrow$	l	l	L	H
H	H	$\nearrow$	h	l	Toggle	
H	H	$\nearrow$	l	h		
H	H	$\nearrow$	h	h	Q	$\overline{Q}$
H	H	L	X	X	H	L
H	H	L	X	X	Q	$\overline{Q}$

H (h) = HIGH Voltage Level
L (l) = LOW Voltage Level
 $\nearrow$ = LOW-to-HIGH Transition
X = Immaterial
Q₀ ($\overline{Q}_0$) = Before LOW-to-HIGH Transition of Clock
Lower case letters indicate the state of the referenced output one setup time prior to the LOW-to-HIGH clock transition.

Unit Loading/Fan Out

Pin Names	Description	U.L. HIGH/LOW	Input I _{IH} /I _{IL} Output I _{OH} /I _{OL}
J ₁ , J ₂ , $\overline{K}_1$, $\overline{K}_2$	Data Inputs	1.0/1.0	20 μ A/-0.6 mA
CP ₁ , CP ₂	Clock Pulse Inputs (Active Rising Edge)	1.0/1.0	20 μ A/-0.6 mA
$\overline{C_{D1}}$, $\overline{C_{D2}}$	Direct Clear Inputs (Active LOW)	1.0/3.0	20 μ A/-1.8 mA
$\overline{S_{D1}}$, $\overline{S_{D2}}$	Direct Set Inputs (Active LOW)	1.0/3.0	20 μ A/-1.8 mA
Q ₁ , Q ₂ , $\overline{Q}_1$, $\overline{Q}_2$	Outputs	50/33.3	-1 mA/20 mA

Block Diagram



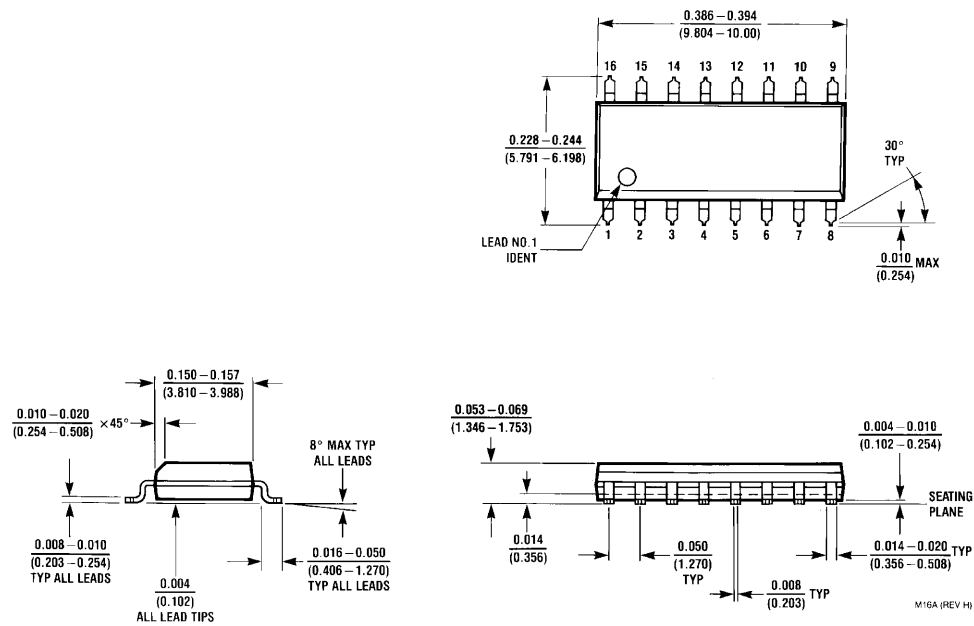
Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings ^(Note 1)				Recommended Operating Conditions			
Storage Temperature			–65°C to +150°C	Free Air Ambient Temperature			0°C to +70°C
Ambient Temperature under Bias			–55°C to +125°C	Supply Voltage			+4.5V to +5.5V
Junction Temperature under Bias			–55°C to +175°C				
V _{CC} Pin Potential to Ground Pin			–0.5V to +7.0V				
Input Voltage (Note 2)			–0.5V to +7.0V				
Input Current (Note 2)			–30 mA to +5.0 mA				
Voltage Applied to Output in HIGH State (with V _{CC} = 0V)							
Standard Output			–0.5V to V _{CC}				
3-STATE Output			–0.5V to +5.5V				
Current Applied to Output in LOW State (Max)			twice the rated I _{OL} (mA)				
Note 1: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied. Note 2: Either voltage limit or current limit is sufficient to protect inputs.							
DC Electrical Characteristics							
Symbol	Parameter	Min	Typ	Max	Units	V _{CC}	Conditions
V _{IH}	Input HIGH Voltage	2.0			V		Recognized as a HIGH Signal
V _{IL}	Input LOW Voltage			0.8	V		Recognized as a LOW Signal
V _{CD}	Input Clamp Diode Voltage			–1.2	V	Min	I _{IN} = –18 mA
V _{OH}	Output HIGH Voltage	10% V _{CC} 5% V _{CC}	2.5 2.7		V	Min	I _{OH} = –1 mA I _{OH} = –1 mA
V _{OL}	Output LOW Voltage	10% V _{CC}		0.5	V	Min	I _{OL} = 20 mA
I _{IH}	Input HIGH Current			5.0	μA	Max	V _{IN} = 2.7V
I _{BVI}	Input HIGH Current Breakdown Test			7.0	μA	Max	V _{IN} = 7.0V
I _{CEX}	Output HIGH Leakage Current			50	μA	Max	V _{OUT} = V _{CC}
V _{ID}	Input Leakage Test	4.75			V	0.0	I _{ID} = 1.9 μA All Other Pins Grounded
I _{OD}	Output Leakage Circuit Current			3.75	μA	0.0	V _{IOD} = 150 mV All Other Pins Grounded
I _{IL}	Input LOW Current			–0.6 –1.8	mA mA	Max Max	V _{IN} = 0.5V (J _n , $\overline{K}_n$) V _{IN} = 0.5V ($\overline{C}_{Dn}$, $\overline{S}_{Dn}$)
I _{OS}	Output Short-Circuit Current	–60		–150	mA	Max	V _{OUT} = 0V
I _{CC}	Power Supply Current		11.7	17.0	mA	Max	CP = 0V

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AC Electrical Characteristics							
Symbol	Parameter	T _A = +25°C V _{CC} = +5.0V C _L = 50 pF			T _A = 0°C to +70°C V _{CC} = +5.0V C _L = 50 pF		Units
		Min	Typ	Max	Min	Max	
f _{MAX}	Maximum Clock Frequency	100	125		90		MHz
t _{PLH}	Propagation Delay CP _n to Q _n or $\overline{Q}_n$	3.8	5.3	7.0	3.8	8.0	ns
t _{PHL}	CP _n to Q _n or $\overline{Q}_n$	4.4	6.2	8.0	4.4	9.2	
t _{PLH}	Propagation Delay	3.2	5.2	7.0	3.2	8.0	ns
t _{PHL}	$\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to Q _n or $\overline{Q}_n$	3.5	7.0	9.0	3.5	10.5	ns
AC Operating Requirements							
Symbol	Parameter	T _A = +25°C V _{CC} = +5.0V		T _A = 0°C to +70°C V _{CC} = +5.0V		Units	
		Min	Max	Min	Max		
t _S (H)	Setup Time, HIGH or LOW	3.0		3.0		ns	
t _S (L)	J _n or $\overline{K}_n$ to CP _n	3.0		3.0			
t _H (H)	Hold Time, HIGH or LOW	1.0		1.0			
t _H (L)	J _n or $\overline{K}_n$ to CP _n	1.0		1.0			
t _W (H)	CP _n Pulse Width	4.0		4.0		ns	
t _W (L)	HIGH or LOW	5.0		5.0			
t _W (L)	$\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ Pulse Width LOW	4.0		4.0		ns	
t _{REC}	Recovery Time $\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to CP	2.0		2.0		ns	

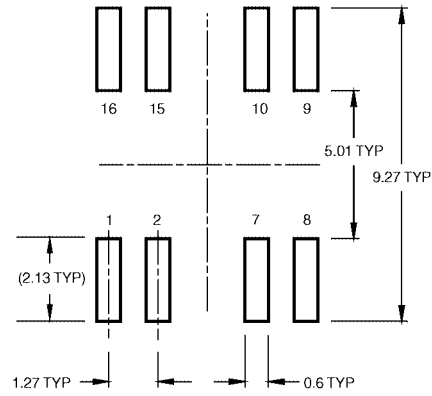
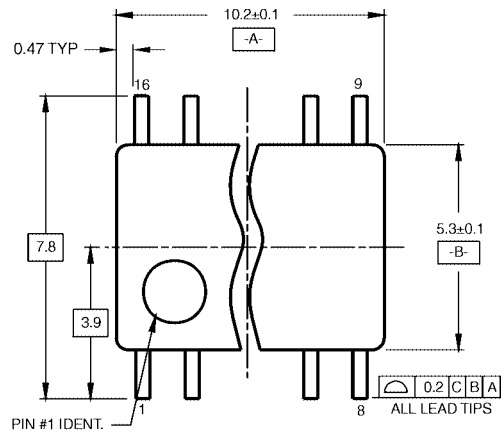
Physical Dimensions inches (millimeters) unless otherwise noted



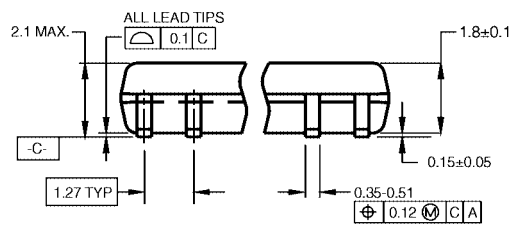
16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow Package Number M16A

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



LAND PATTERN RECOMMENDATION

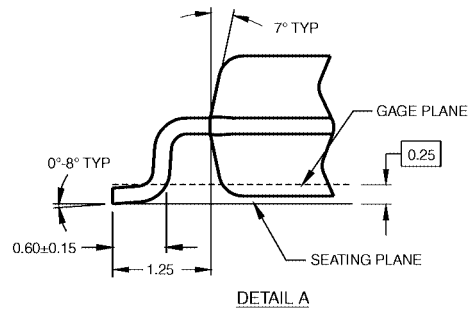
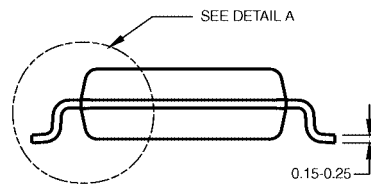


DIMENSIONS ARE IN MILLIMETERS

NOTES:

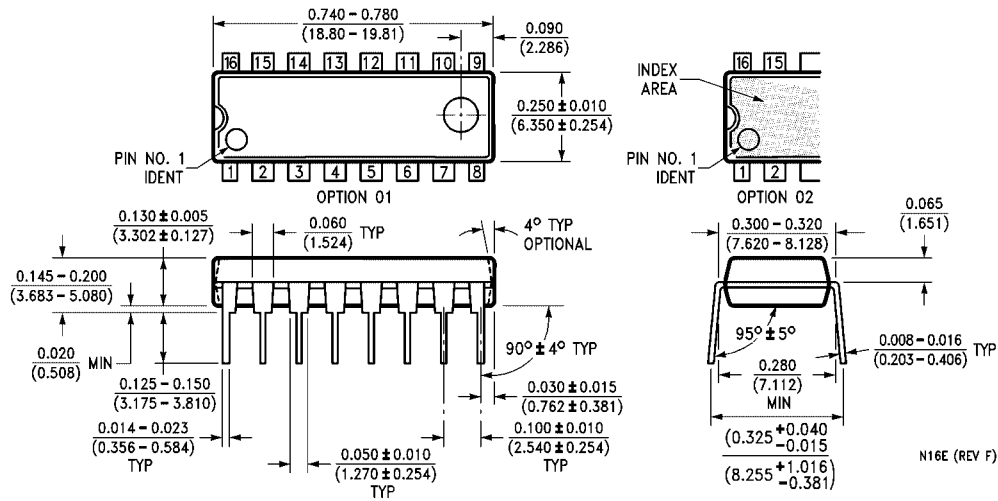
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- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M16DRevB1



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

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



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