

54F/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 flip-flop (refer to 'F74 data sheet) by connecting the J and $\bar{K}$ inputs.

Asynchronous Inputs:

LOW input to $\bar{S}_D$ sets Q to HIGH level

LOW input to $\bar{C}_D$ sets Q to LOW level

Clear and Set are independent of clock

Simultaneous LOW on $\bar{C}_D$ and $\bar{S}_D$ makes both Q and $\bar{Q}$ HIGH

Features

- Guaranteed 4000V minimum ESD protection.

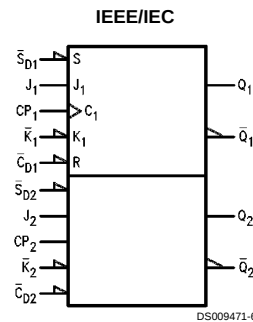
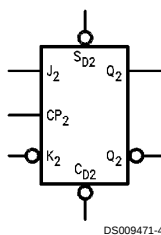
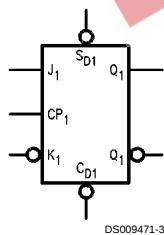
Ordering Code: See Section 0

Commercial	Military	Package Number	Package Description
74F109PC		N16E	16-Lead (0.300" Wide) Molded Dual-in-Line
	54F109DM (Note 2)	J16A	16-Lead Ceramic Dual-in-Line
74F109SC (Note 1)		M16A	16-Lead (0.150" Wide) Molded Small Outline, JEDEC
74F109SJ (Note 1)		M16D	16-Lead (0.300" Wide) Molded Small Outline, EIAJ
	54F109FM (Note 2)	W16A	16-Lead Cerpack
	54F109LM (Note 2)	E20A	16-Lead Ceramic Leadless Chip Carrier, Type C

Note 1: Devices also available in 13" reel. Use suffix = SCX and SJX.

Note 2: Military grade device with environmental and burn-in processing. Use suffix = DMQB, FMQB and LMQB.

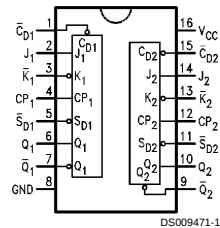
Logic Symbols



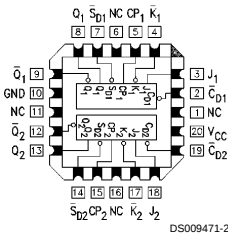
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Connection Diagrams

Pin Assignment
for DIP, SOIC and Flatpak



Pin Assignment
for LCC



Unit Loading/Fan Out

See Section 0 for U.L. definitions

Pin Names	Description	54F/74F	
		U.L. HIGH/LOW	Input I_{IH}/I_{IL} Output I_{OH}/I_{OL}
$J_1, J_2, \bar{K}_1, \bar{K}_2$	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
$\bar{C}_{D1}, \bar{C}_{D2}$	Direct Clear Inputs (Active LOW)	1.0/3.0	20 μ A/-1.8 mA
$\bar{S}_{D1}, \bar{S}_{D2}$	Direct Set Inputs (Active LOW)	1.0/3.0	20 μ A/-1.8 mA
$Q_1, Q_2, \bar{Q}_1, \bar{Q}_2$	Outputs	50/33.3	-1 mA/20 mA

Truth Table

Inputs					Outputs	
$\bar{S}_D$	$\bar{C}_D$	CP	J	$\bar{K}$	Q	$\bar{Q}$
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	Q_0	$\bar{Q}_0$
H	H	$\nearrow$	h	h	H	L
H	H	L	X	X	Q_0	$\bar{Q}_0$

H (h) = HIGH Voltage Level

L (l) = LOW Voltage Level

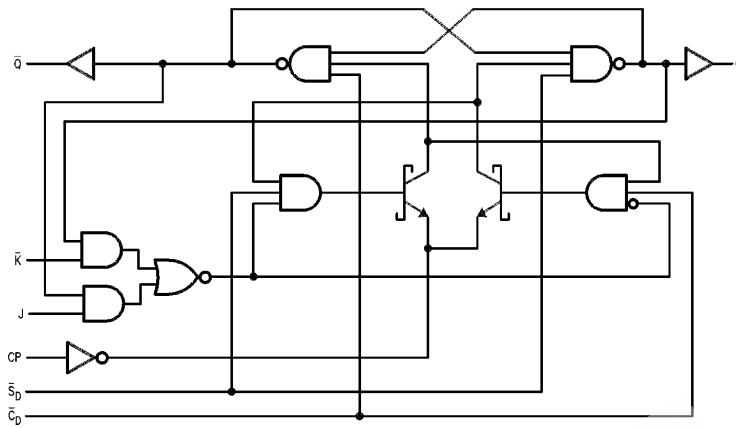
$\nearrow$ = LOW-to-HIGH Transition

X = Immaterial

Q_0 ($\bar{Q}_0$) = 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.

Logic Diagram (One Half Shown)



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

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Absolute Maximum Ratings (Note 3)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Storage Temperature	-65°C to +150°C
Ambient Temperature under Bias	-55°C to +125°C
Junction Temperature under Bias	-55°C to +175°C
Plastic	-55°C to +150°C
V _{CC} Pin Potential to Ground Pin	-0.5V to +7.0V
Input Voltage (Note 4)	-0.5V to +7.0V
Input Current (Note 4)	-30 mA to +5.0 mA
Voltage Applied to Output in HIGH State (with V _{CC} = 0V)	
Standard Output	-0.5V to V _{CC}
TRI-STATE® Output	-0.5V to +5.5V

Current Applied to Output in LOW State (Max)	twice the rated I _{OL} (mA)
ESD Last Passing Voltage (Min)	4000V

Recommended Operating Conditions

Free Air Ambient Temperature	
Military	-55°C to +125°C
Commercial	0°C to +70°C
Supply Voltage	
Military	+4.5V to +5.5V
Commercial	+4.5V to +5.5V

Note 3: 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 4: Either voltage limit or current limit is sufficient to protect inputs.

DC Electrical Characteristics

Symbol	Parameter		54F/74F			Units	V _{CC}	Conditions
			Min	Typ	Max			
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	54F 10% V _{CC}	2.5			V	Min	I _{OH} = -1 mA
		74F 10% V _{CC}	2.5					I _{OH} = -1 mA
		74F 5% V _{CC}	2.7					I _{OH} = -1 mA
V _{OL}	Output LOW Voltage	54F 10% V _{CC}			0.5	V	Min	I _{OL} = 20 mA
		74F 10% V _{CC}			0.5			I _{OL} = 20 mA
I _{IH}	Input HIGH Current	54F			20.0	μA	Max	V _{IN} = 2.7V
		74F			5.0			
I _{BVI}	Input HIGH Current Breakdown Test	54F			100	μA	Max	V _{IN} = 7.0V
		74F			7.0			
I _{CEX}	Output HIGH Leakage Current	54F			250	μA	Max	V _{OUT} = V _{CC}
		74F			50			
V _{ID}	Input Leakage Test	74F	4.75			V	0.0	I _{ID} = 1.9 μA All Other Pins Grounded
I _{OD}	Output Leakage Circuit Current	74F			3.75	μA	0.0	V _{IOD} = 150 mV All Other Pins Grounded
I _{IL}	Input LOW Current				-0.6	mA	Max	V _{IN} = 0.5V (J _n , K _n)
					-1.8	mA	Max	V _{IN} = 0.5V (C _{Dn} , 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

AC Electrical Characteristics

See Section 0 for Waveforms and Load Configurations

Symbol	Parameter	74F			54F		74F		Units	Fig. No.
		T _A = +25°C V _{CC} = +5.0V C _L = 50 pF			T _A , V _{CC} = Mil C _L = 50 pF		T _A , V _{CC} = Com C _L = 50 pF			
		Min	Typ	Max	Min	Max	Min	Max		
f _{max}	Maximum Clock Frequency	100	125		70		90		MHz	◆◆◆◆

AC Electrical Characteristics (Continued)

See Section 0 for Waveforms and Load Configurations

Symbol	Parameter	74F			54F		74F		Units	Fig. No.
		$T_A = +25^{\circ}\text{C}$ $V_{CC} = +5.0\text{V}$ $C_L = 50\text{ pF}$			$T_A, V_{CC} = \text{Mil}$ $C_L = 50\text{ pF}$		$T_A, V_{CC} = \text{Com}$ $C_L = 50\text{ pF}$			
		Min	Typ	Max	Min	Max	Min	Max		
t_{PLH}	Propagation Delay	3.8	5.3	7.0	3.8	9.0	3.8	8.0	ns	◆◆◆◆
t_{PHL}	CP_n to Q_n or $\overline{Q}_n$	4.4	6.2	8.0	4.4	10.5	4.4	9.2		
t_{PLH}	Propagation Delay	3.2	5.2	7.0	3.2	9.0	3.2	8.0		
t_{PHL}	$\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to Q_n or $\overline{Q}_n$	3.5	7.0	9.0	3.5	11.5	3.5	10.5	ns	◆◆◆◆

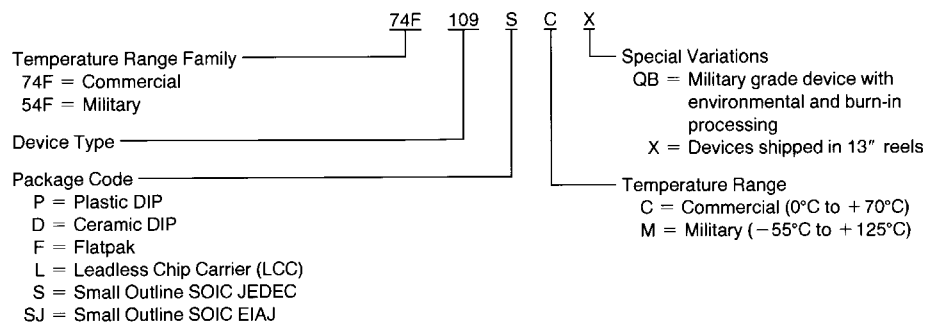
AC Operating Requirements

See Section 0 for Waveforms

Symbol	Parameter	74F		54F		74F		Units	Fig. No.
		$T_A = +25^{\circ}\text{C}$ $V_{CC} = +5.0\text{V}$		$T_A, V_{CC} = \text{Mil}$		$T_A, V_{CC} = \text{Com}$			
		Min	Max	Min	Max	Min	Max		
$t_s(\text{H})$	Setup Time, HIGH or LOW	3.0		3.0		3.0		ns	◆◆◆◆
$t_s(\text{L})$	J_n or $\overline{K}_n$ to CP_n	3.0		4.0		3.0			
$t_h(\text{H})$	Hold Time, HIGH or LOW	1.0		1.0		1.0			
$t_h(\text{L})$	J_n or $\overline{K}_n$ to CP_n	1.0		1.0		1.0			
$t_w(\text{H})$	CP_n Pulse Width	4.0		4.0		4.0		ns	◆◆◆◆
$t_w(\text{L})$	HIGH or LOW	5.0		5.0		5.0			
$t_w(\text{L})$	$\overline{\text{C}}_{\text{Dn}}$ or $\overline{\text{S}}_{\text{Dn}}$ Pulse Width, LOW	4.0		4.0		4.0		ns	◆◆◆◆
t_{rec}	Recovery Time $\overline{\text{C}}_{\text{Dn}}$ or $\overline{\text{S}}_{\text{Dn}}$ to CP	2.0		2.0		2.0		ns	◆◆◆◆

Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:



DS009471-7

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Top View

Overall width: 0.350 ± 0.008 (8.890 ± 0.203)

Side View

Overall height: $0.063 - 0.075$ (1.600 - 1.905)

Bottom View

Pin 1 Index: $0.077 - 0.093$ (1.959 - 2.362)

Pin 1 Index: $0.045 - 0.055$ (1.143 - 1.397) TYP

Pin 1 Index: $0.067 - 0.083$ (1.702 - 2.108) TYP

Pin 1 Index: $0.045 - 0.055$ (1.143 - 1.397) TYP

Pin 1 Index: 0.040 ± 0.010 (1.016 ± 0.254) 3 PLCS

Pin 1 Index: $0.007 - 0.011$ (0.178 - 0.279) R TYP

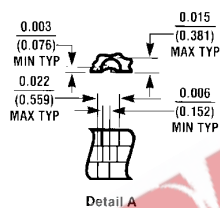
Pin 1 Index: $0.022 - 0.028$ (0.559 - 0.711) TYP

Pin 1 Index: 0.015 (0.381) MIN TYP

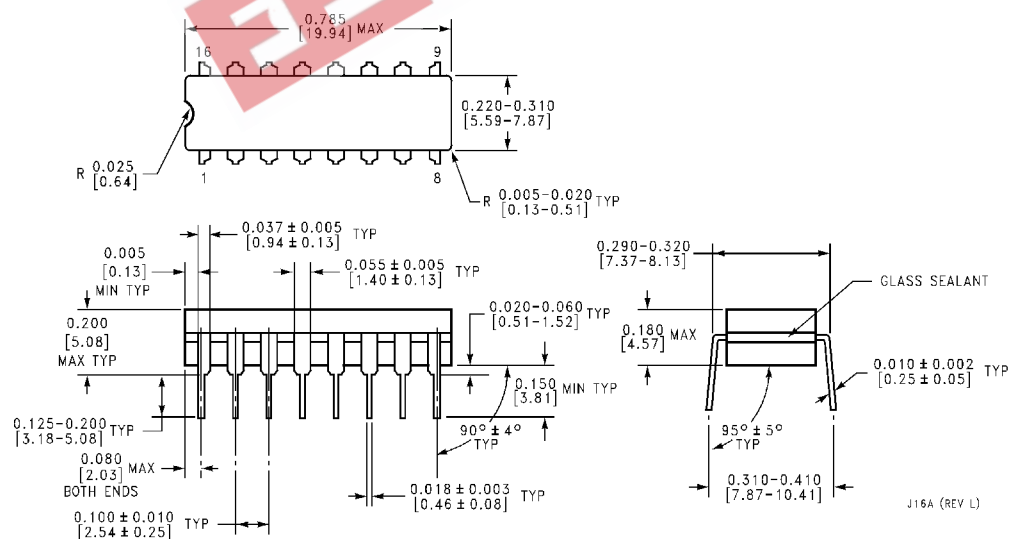
Pin 1 Index: 0.200 ± 0.005 (5.080 ± 0.127) TYP

Pin 1 Index: $45^\circ \times 0.015 \pm 0.010$ (0.381 ± 0.254)

DETAIL A

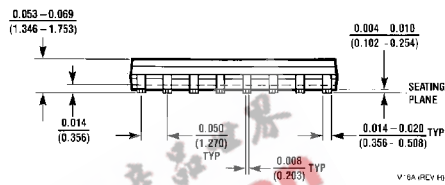
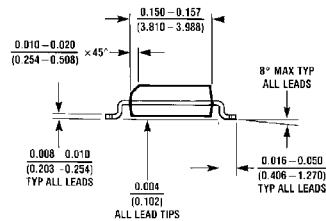
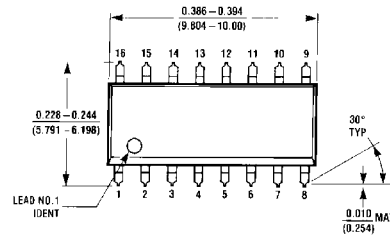


E20A (REV 01)

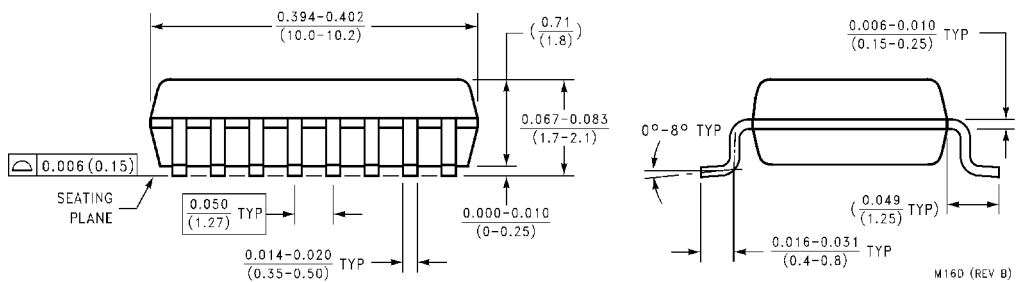
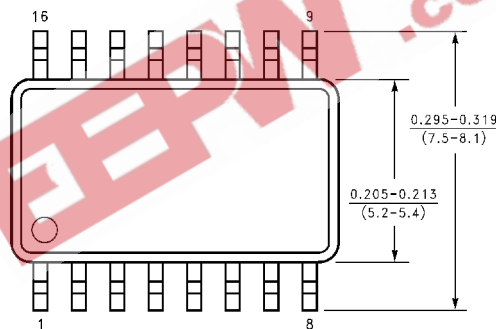


16-Lead Ceramic Dual-In-Line Package (D)
NS Package Number J16A

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

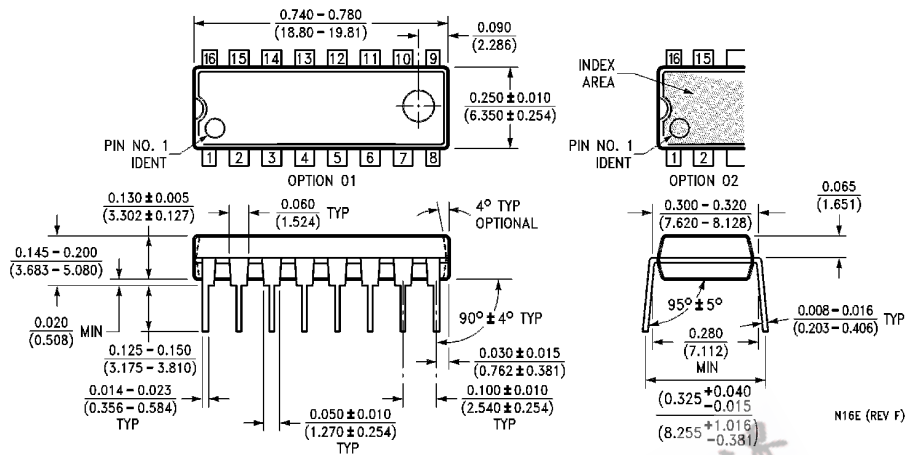


16-Lead (0.150" Wide) Molded Small Outline Package, JEDEC (S)
NS Package Number M16A

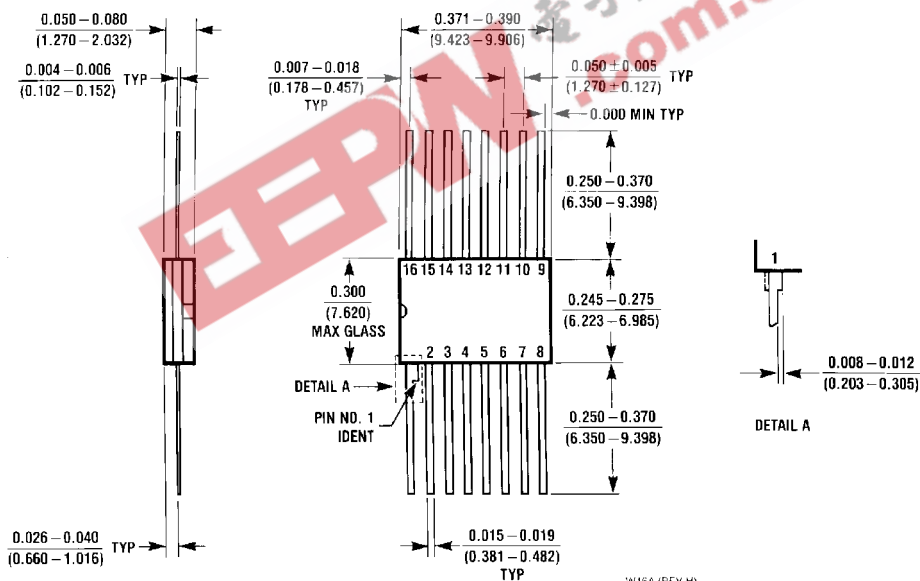


16-Lead (0.300" Wide) Molded Small Outline Package, EIAJ (SJ)
NS Package Number M16D

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



16-Lead (0.300" Wide) Molded Dual-In-Line Package (P)
NS Package Number N16E



16-Lead Ceramic Flatpak (F)
NS Package Number W16A

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