

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.

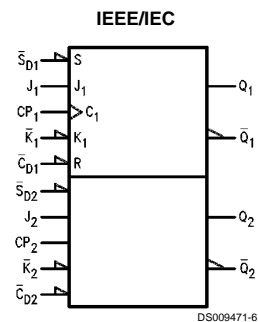
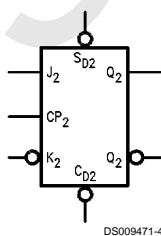
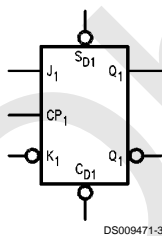
Ordering Code: See Section 0

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.

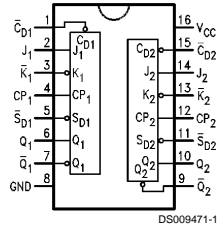
Logic Symbols



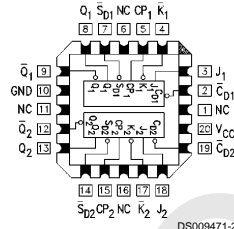
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Connection Diagrams

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	54F74F	
		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 μA / -0.6 mA
CP_1, CP_2	Clock Pulse Inputs (Active Rising Edge)	1.0/1.0	20 μA / -0.6 mA
$\bar{C}_{D1}, \bar{C}_{D2}$	Direct Clear Inputs (Active LOW)	1.0/3.0	20 μA / -1.8 mA
$\bar{S}_{D1}, \bar{S}_{D2}$	Direct Set Inputs (Active LOW)	1.0/3.0	20 μA / -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	↗	l	l	L	H
H	H	↗	h	l	Toggle	
H	H	↗	l	h	Q_0	\bar{Q}_0
H	H	↗	h	h	H	L
H	H	L	X	X	Q_0	\bar{Q}_0

H (h) = HIGH Voltage Level

L (l) = LOW Voltage Level

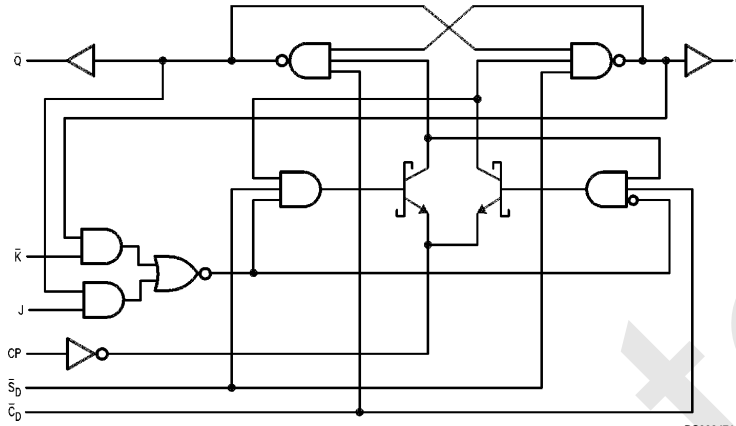
↗ = LOW-to-HIGH Transition

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)



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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 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 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			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 \bar{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	ns	◆◆◆
t_{PHL}	\bar{C}_{Dn} or \bar{S}_{Dn} to Q_n or \bar{Q}_n	3.5	7.0	9.0	3.5	11.5	3.5	10.5		

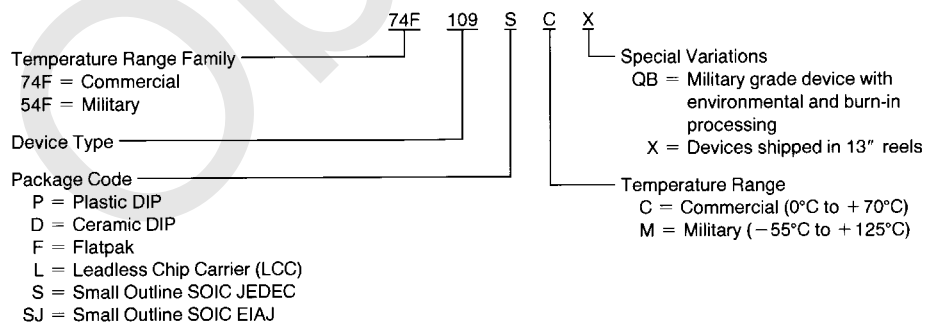
AC Operating Requirements

See Section 0 for Waveforms

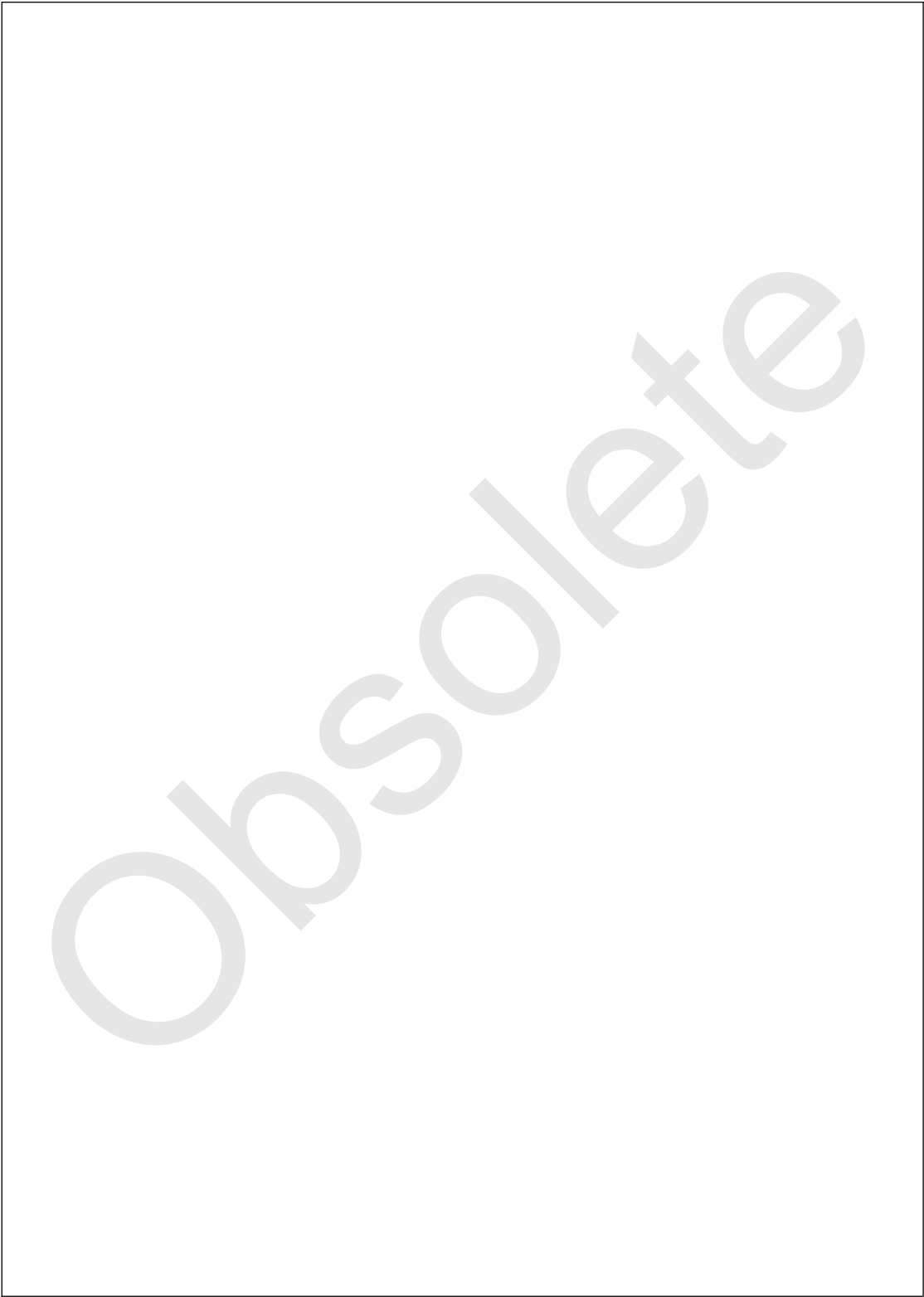
Symbol	Parameter	74F		54F		74F		Units	Fig. No.
		$T_A = +25^\circ\text{C}$ $V_{CC} = +5.0\text{V}$		$T_A, V_{CC} = \text{Mil}$		$T_A, V_{CC} = \text{Com}$			
		Min	Max	Min	Max	Min	Max		
$t_s(H)$	Setup Time, HIGH or LOW	3.0		3.0		3.0		ns	◆◆◆
$t_s(L)$	J_n or \bar{K}_n to CP_n	3.0		4.0		3.0			
$t_h(H)$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

Ordering Information

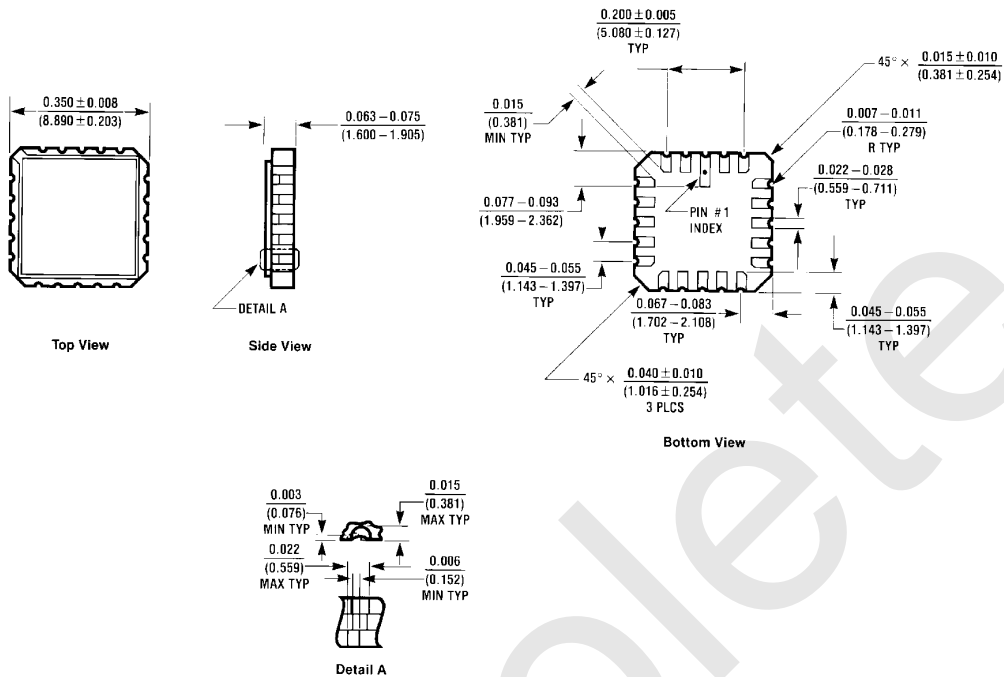
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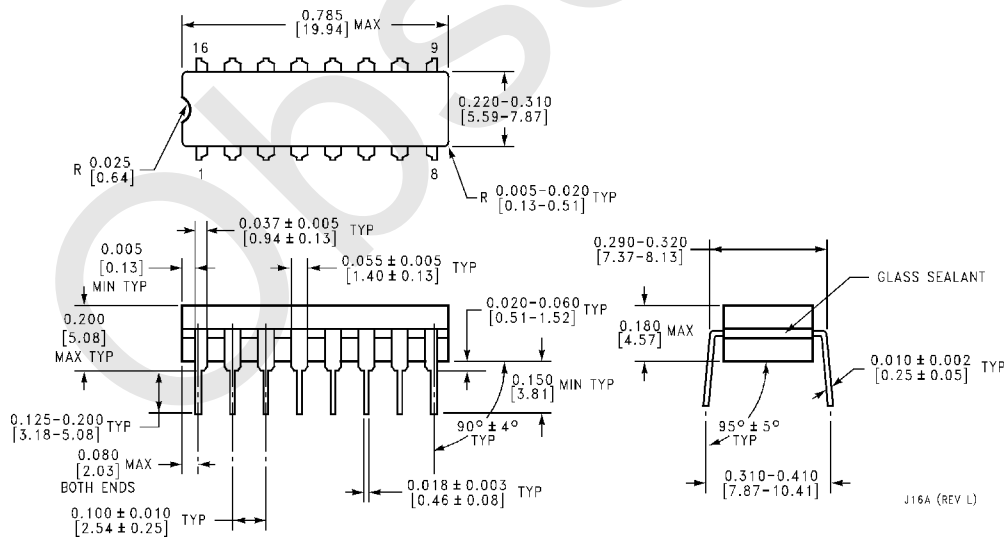
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Physical Dimensions inches (millimeters) unless otherwise noted

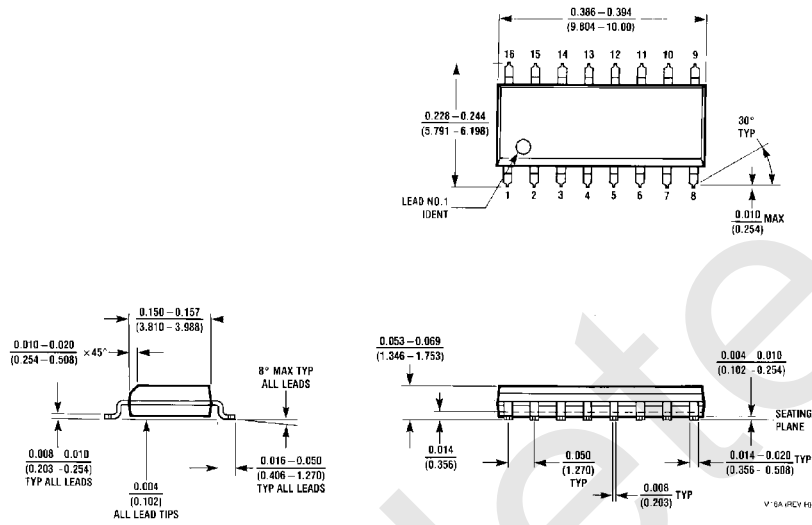


**20-Lead Ceramic Leadless Chip Carrier (L)
 NS Package Number E20A**

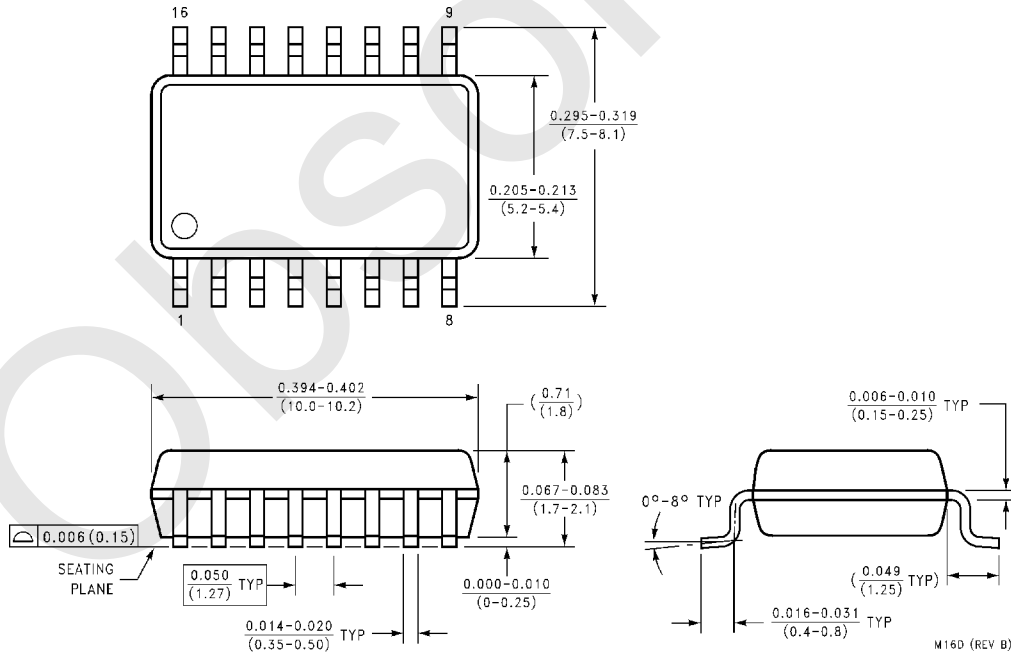


**16-Lead Ceramic Dual-In-Line Package (D)
 NS Package Number J16A**

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

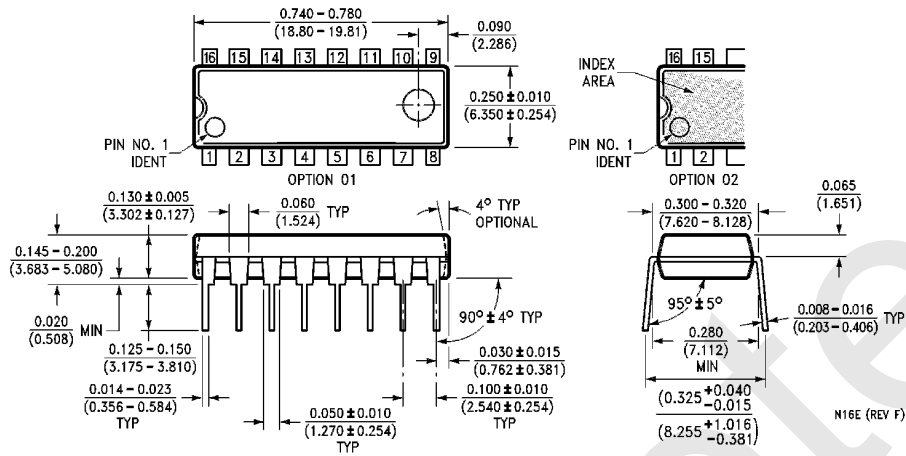


**16-Lead (0.150" Wide) Molded Small Outline Package, JEDEC (S)
NS Package Number M16A**

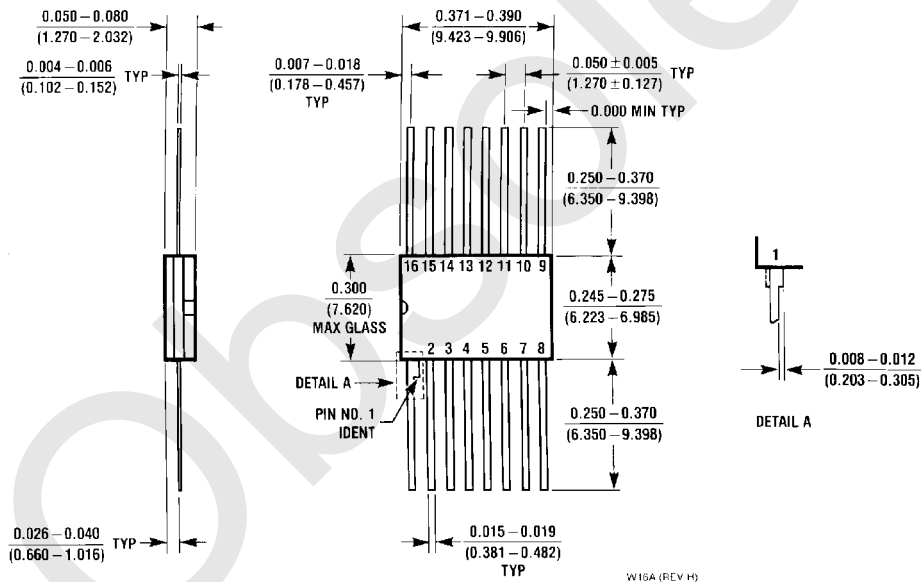


**16-Lead (0.300" Wide) Molded Small Outline Package, EIAJ (SJ)
NS Package Number M16D**

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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