National Semiconductor

November 1994

54F/74F175 Quad D Flip-Flop

General Description

The 'F175 is a high-speed quad D flip-flop. The device is useful for general flip-flop requirements where clock and clear inputs are common. The information on the D inputs is stored during the LOW-to-HIGH clock transition. Both true and complemented outputs of each flip-flop are provided. A Master Reset input resets all flip-flops, independent of the Clock or D inputs, LOW.

Features

- Edge-triggered D-type inputs
- Buffered positive edge-triggered clock
- Asynchronous common reset
- True and complement output
- Guaranteed 4000V minimum ESD protection

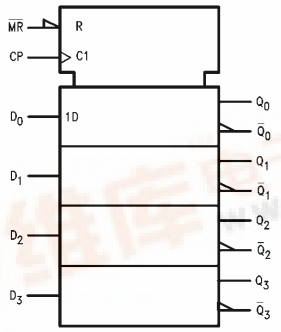
Commercial	Military	Package Number	Package Description
74F175PC		N16E	16-Lead (0.300″ Wide) Molded Dual-In-Line
	54F175DM (Note 2)	J16A	16-Lead Ceramic Dual-In-Line
74F175SC (Note 1)		M16A	16-Lead (0.150″ Wide) Molded Small Outline, JEDEC
74F175SJ (Note 1)		M16D	16-Lead (0.300″ Wide) Molded Small Outline, EIAJ
	54F175FM (Note 2)	W16A	16-Lead Cerpack
	54F175LM (Note 2)	E20A	20-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

IEEE/IEC



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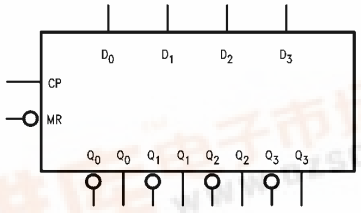

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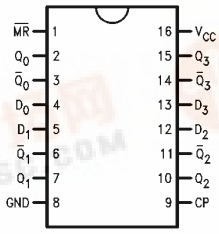
Connection Diagrams

Pin Assignment for DIP, SOIC and Flatpak



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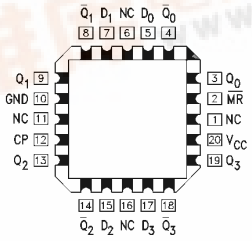
Pin Assignment for LCC



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Unit Loading/Fan Out

Pin Names	Description	54F/74F	
		U.L. HIGH/LOW	Input I_{IH}/I_{IL} Output I_{OH}/I_{OL}
D_0-D_3	Data Inputs	1.0/1.0	20 μA/ $-$0.6 mA
CP	Clock Pulse Input (Active Rising Edge)	1.0/1.0	20 μA/ $-$0.6 mA
$\overline{MR}$	Master Reset Input (Active LOW)	1.0/1.0	20 μA/ $-$0.6 mA
Q_0-Q_3	True Outputs	50/33.3	$-$1 mA/20 mA
$\overline{Q}_0-\overline{Q}_3$	Complement Outputs	50/33.3	$-$1 mA/20 mA

Functional Description

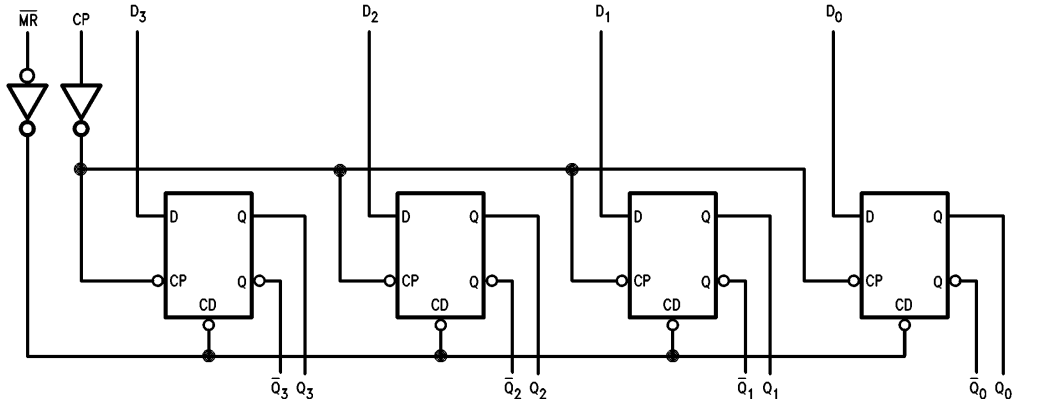
The 'F175 consists of four edge-triggered D flip-flops with individual D inputs and Q and $\overline{Q}$ outputs. The Clock and Master Reset are common. The four flip-flops will store the state of their individual D inputs on the LOW-to-HIGH clock (CP) transition, causing individual Q and $\overline{Q}$ outputs to follow. A LOW input on the Master Reset ($\overline{MR}$) will force all Q outputs LOW and $\overline{Q}$ outputs HIGH independent of Clock or Data inputs. The 'F175 is useful for general logic applications where a common Master Reset and Clock are acceptable.

Truth Table

Inputs			Outputs	
$\overline{MR}$	CP	D_n	Q_n	$\overline{Q}_n$
L	X	X	L	H
H	⌐	H	H	L
H	⌐	L	L	H

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
⌐ = LOW-to-HIGH Clock Transition

Logic Diagram



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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 1)

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 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}
TRI-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.

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

DC Electrical Characteristics

Symbol	Parameter		54F/74F Min	54F/74F Typ	54F/74F 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	54F 10% V_{CC} 74F 10% V_{CC} 74F 5% V_{CC}	2.5 2.5 2.7			V	Min	I_{OH} = −1 mA I_{OH} = −1 mA I_{OH} = −1 mA
V_{OL}	Output LOW Voltage	54F 10% V_{CC} 74F 10% V_{CC}			0.5 0.5	V	Min	I_{OL} = 20 mA I_{OL} = 20 mA
I_{IH}	Input HIGH Current	54F 74F			20.0 5.0	μA	Max	V_{IN} = 2.7V
I_{BVI}	Input HIGH Current Breakdown Test	54F 74F			100 7.0	μA	Max	V_{IN} = 7.0V
I_{CEX}	Output HIGH Leakage Current	54F 74F			250 50	μA	Max	V_{OUT} = V_{CC}
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
I_{OS}	Output Short-Circuit Current		−60		−150	mA	Max	V_{OUT} = 0V
I_{CC}	Power Supply Current			22.5	34.0	mA	Max	CP = ⌐ D_n = $\overline{MR}$ = HIGH

AC Electrical Characteristics

Symbol	Parameter	74F $T_A = +25°C$, $V_{CC} = +5.0V$, $C_L = 50$ pF			54F T_A, V_{CC} = Mil, $C_L = 50$ pF		74F T_A, V_{CC} = Com, $C_L = 50$ pF		Units
		Min	Typ	Max	Min	Max	Min	Max	
f_{max}	Maximum Clock Frequency	100	140		80		100		MHz
t_{PLH} t_{PHL}	Propagation Delay CP to Q_n or $\overline{Q}_n$	4.0 4.0	5.0 6.5	6.5 8.5	3.5 4.0	8.5 10.5	4.0 4.0	7.5 9.5	ns
t_{PHL}	Propagation Delay $\overline{MR}$ to Q_n	4.5	9.0	11.5	4.5	15.0	4.5	13.0	ns
t_{PLH}	Propagation Delay $\overline{MR}$ to $\overline{Q}_n$	4.0	6.5	8.0	4.0	10.0	4.0	9.0	ns

AC Operating Requirements

Symbol	Parameter	74F $T_A = +25°C$, $V_{CC} = +5.0V$		54F T_A, V_{CC} = Mil		74F T_A, V_{CC} = Com		Units
		Min	Max	Min	Max	Min	Max	
$t_s(H)$ $t_s(L)$	Setup Time, HIGH or LOW D_n to CP	3.0 3.0		3.0 3.0		3.0 3.0		ns
$t_h(H)$ $t_h(L)$	Hold Time, HIGH or LOW D_n to CP	1.0 1.0		1.0 2.0		1.0 1.0		
$t_w(H)$ $t_w(L)$	CP Pulse Width HIGH or LOW	4.0 5.0		4.0 5.0		4.0 5.0		ns
$t_w(L)$	$\overline{MR}$ Pulse Width, LOW	5.0		5.0		5.0		ns
t_{rec}	Recovery Time, $\overline{MR}$ to CP	5.0		5.0		5.0		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:

74F 175 S C X

Temperature Range Family
- 74F = Commercial
- 54F = Military

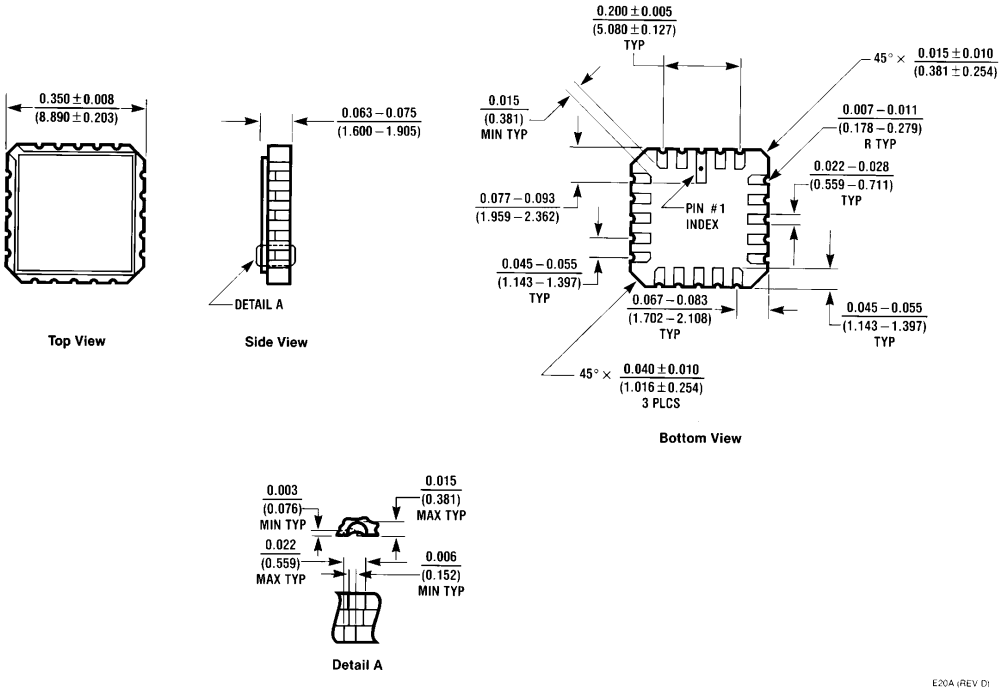
Device Type

Package Code
- P = Plastic DIP
- D = Ceramic DIP
- F = Flatpak
- L = Leadless Chip Carrier (LCC)
- S = Small Outline SOIC JEDEC
- SJ = Small Outline SOIC EIAJ

Temperature Range
- C = Commercial (0°C to +70°C)
- M = Military (−55°C to +125°C)

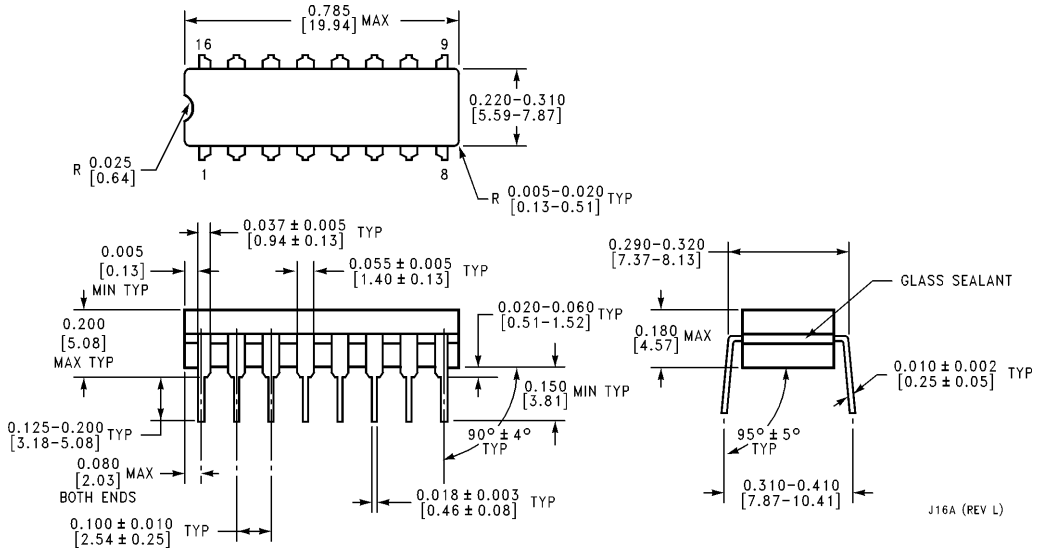
Special Variations
- QB = Military grade device with environmental and burn-in processing
- X = Devices shipped in 13″ reel

Physical Dimensions inches (millimeters)

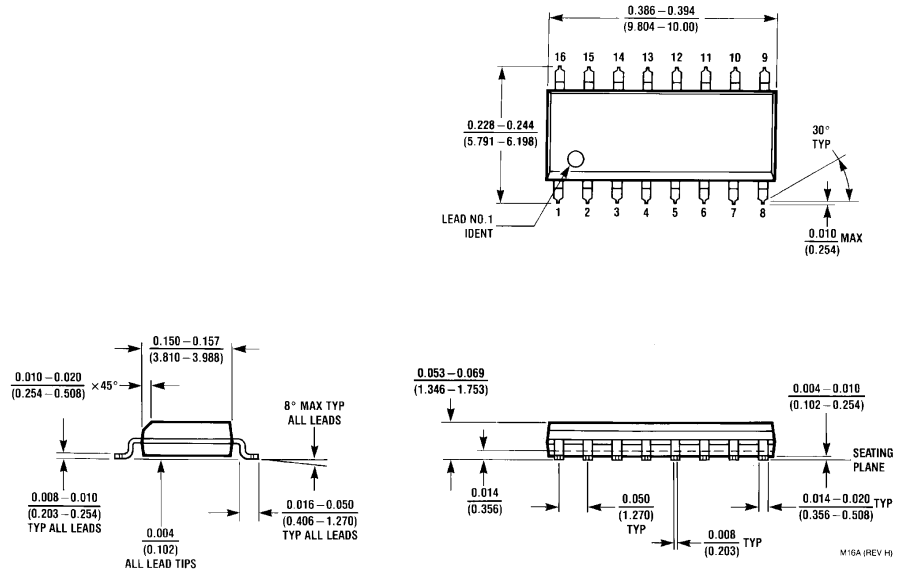


20-Terminal Ceramic Leadless Chip Carrier (L)
NS Package Number E20A

Physical Dimensions inches (millimeters) (Continued)

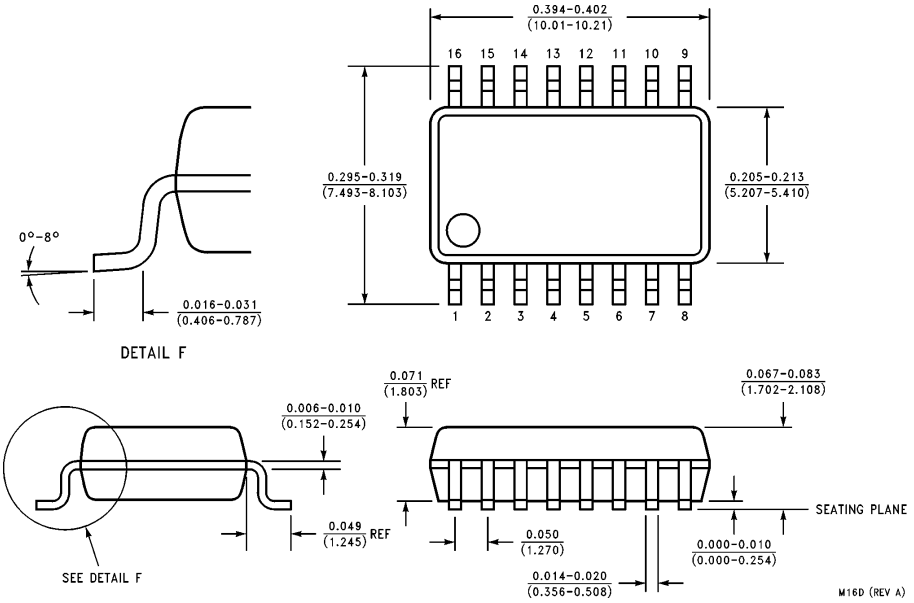


16-Lead Ceramic Dual-In-Line Package (D)
NS Package Number J16A

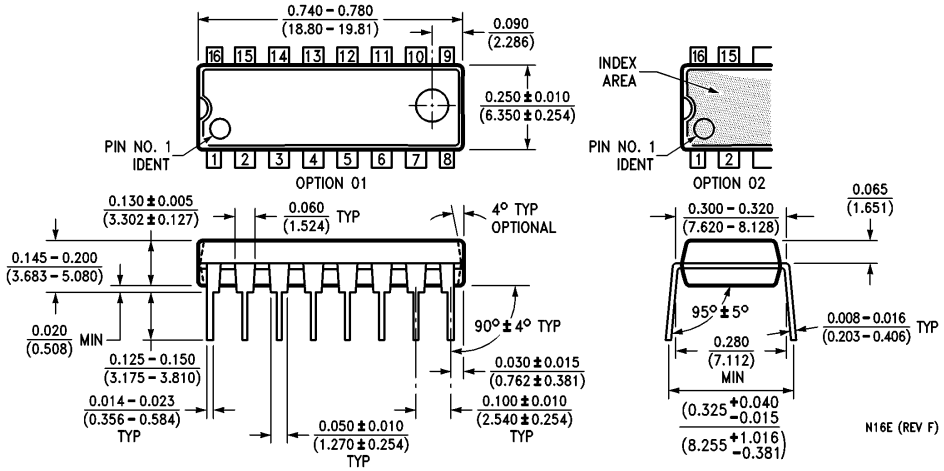


16-Lead (0.150″ Wide) Molded Small Outline Package, JEDEC (S)
NS Package Number M16A

Physical Dimensions inches (millimeters) (Continued)

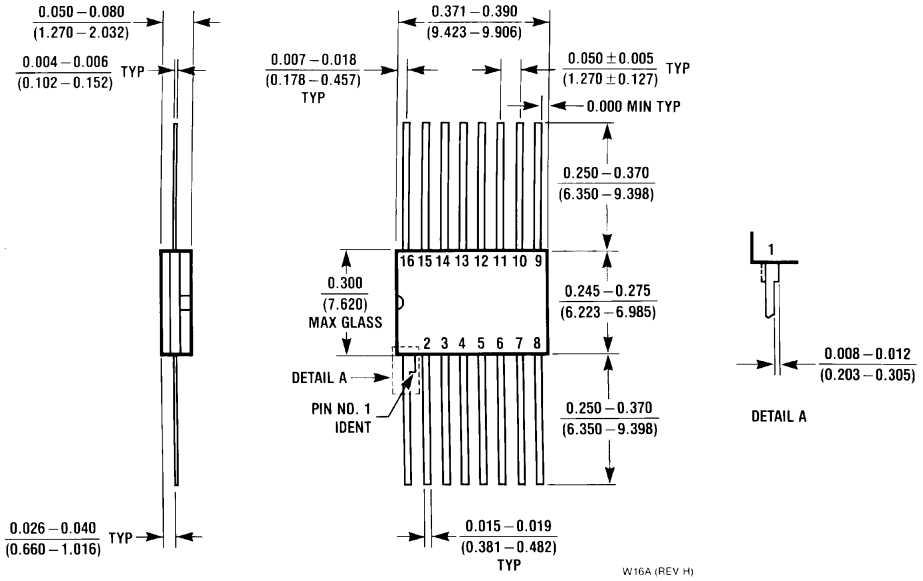


16-Lead (0.300″ Wide) Molded Small Outline Package, EIAJ (SJ)
NS Package Number M16D



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

Physical Dimensions inches (millimeters) (Continued)



16 Lead Ceramic Flatpak (F)
NS Package Number W16A

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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