National Semiconductor

November 1994

54F/74F151A
8-Input Multiplexer

General Description

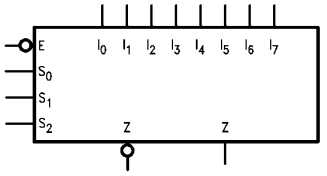
The 'F151A is a high-speed 8-input digital multiplexer. It provides in one package the ability to select one line of data from up to eight sources. The 'F151A can be used as a universal function generator to generate any logic function of four variables. Both assertion and negation outputs are provided.

Commercial	Military	Package Number	Package Description
74F151APC		N16E	16-Lead (0.300″ Wide) Molded Dual-In-Line
	54F151ADM (Note 2)	J16A	16-Lead Ceramic Dual-In-Line
74F151ASC (Note 1)		M16A	16-Lead (0.150″ Wide) Molded Small Outline, JEDEC
74F151ASJ (Note 1)		M16D	16-Lead (0.300″ Wide) Molded Small Outline, EIAJ
	54F151AFM (Note 2)	W16A	16-Lead Cerpack
	54F151ALM (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 = DQMB, FMQB and LMQB.

Logic Symbols



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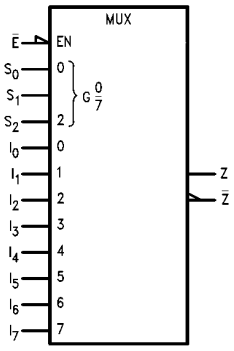
IEEE/IEC



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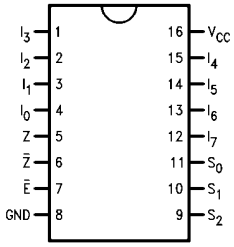
Connection Diagrams

Pin Assignment for DIP, SOIC and Flatpak



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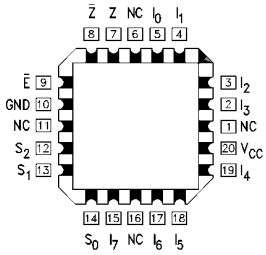
Pin Assignment for LCC



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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}
I_0-I_7	Data Inputs	1.0/1.0	20 μA/$-$0.6 mA
S_0-S_2	Select Inputs	1.0/1.0	20 μA/$-$0.6 mA
$\overline{E}$	Enable Input (Active LOW)	1.0/1.0	20 μA/$-$0.6 mA
Z	Data Output	50/33.3	$-$1 mA/20 mA
$\overline{Z}$	Inverted Data Output	50/33.3	$-$1 mA/20 mA

Functional Description

The 'F151A is a logic implementation of a single pole, 8-position switch with the switch position controlled by the state of three Select inputs, S_0, S_1, S_2. Both assertion and negation outputs are provided. The Enable input ($\overline{E}$) is active LOW. When it is not activated, the negation output is HIGH and the assertion output is LOW regardless of all other inputs. The logic function provided at the output is:

$$Z = \overline{E} \bullet (I_0 \overline{S}_2 \overline{S}_1 \overline{S}_0 + I_1 \overline{S}_2 \overline{S}_1 S_0 + I_2 \overline{S}_2 S_1 \overline{S}_0 + I_3 \overline{S}_2 S_1 S_0 + I_4 S_2 \overline{S}_1 \overline{S}_0 + I_5 S_2 \overline{S}_1 S_0 + I_6 S_2 S_1 \overline{S}_0 + I_7 S_2 S_1 S_0)$$

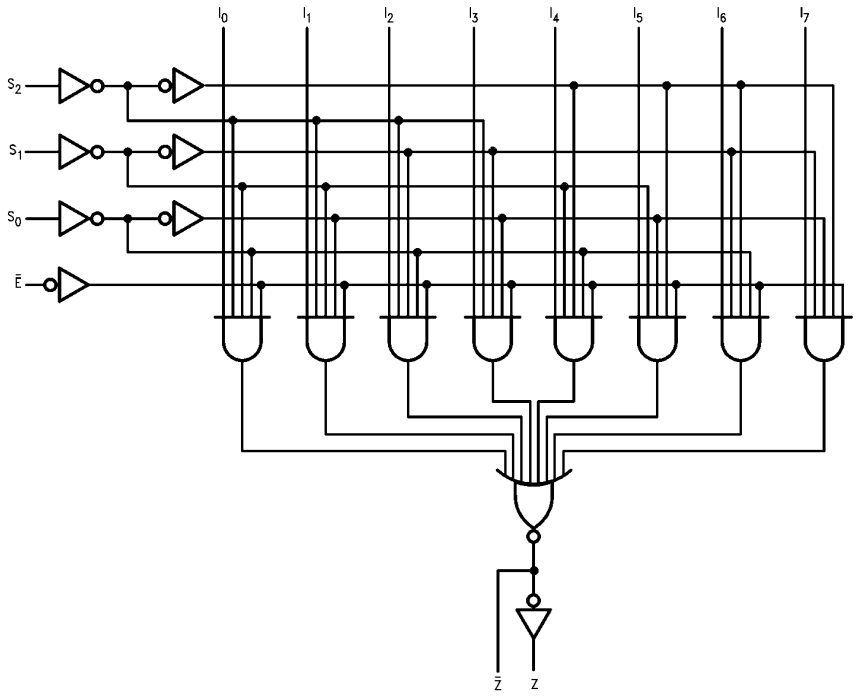
The 'F151A provides the ability, in one package, to select from eight sources of data or control information. By proper manipulation of the inputs, the 'F151A can provide any logic function of four variables and its negation.

Truth Table

Inputs				Outputs	
$\overline{E}$	S_2	S_1	S_0	$\overline{Z}$	Z
H	X	X	X	H	L
L	L	L	L	$\overline{I}_0$	I_0
L	L	L	H	$\overline{I}_1$	I_1
L	L	H	L	$\overline{I}_2$	I_2
L	L	H	H	$\overline{I}_3$	I_3
L	H	L	L	$\overline{I}_4$	I_4
L	H	L	H	$\overline{I}_5$	I_5
L	H	H	L	$\overline{I}_6$	I_6
L	H	H	H	$\overline{I}_7$	I_7

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

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}	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
I_{OS}	Output Short-Circuit Current		−60		−150	mA	Max	V_{OUT} = 0V
I_{CC}	Power Supply Current			13.5	21.0	mA	Max	V_O = 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	
t_{PLH}	Propagation Delay	4.0	6.2	9.0	3.5	11.5	3.5	9.5	ns
t_{PHL}	S_n to $\overline{Z}$	3.2	5.2	7.5	3.0	8.0	3.2	7.5	
t_{PLH}	Propagation Delay	4.5	7.5	10.5	4.5	13.5	4.5	12.0	ns
t_{PHL}	S_n to Z	4.0	6.2	9.0	4.0	9.5	4.0	9.0	
t_{PLH}	Propagation Delay	3.0	4.7	6.1	3.0	7.5	3.0	7.0	ns
t_{PHL}	$\overline{E}$ to $\overline{Z}$	3.0	4.4	6.0	2.5	6.5	2.5	6.0	
t_{PLH}	Propagation Delay	5.0	7.0	9.5	4.0	12.0	4.0	10.5	ns
t_{PHL}	$\overline{E}$ to Z	3.5	5.3	7.0	3.0	8.0	3.0	7.5	
t_{PLH}	Propagation Delay	3.0	4.8	6.5	2.5	7.5	3.0	7.0	ns
t_{PHL}	I_n to $\overline{Z}$	1.5	2.5	4.0	1.5	6.0	1.5	5.0	
t_{PLH}	Propagation Delay	3.0	4.8	6.5	2.5	8.5	2.5	7.5	ns
t_{PHL}	I_n to Z	3.7	5.5	7.0	3.5	9.0	3.7	7.5	

Ordering Information

74F 151A S C X

Temperature Range Family
74F = Commercial
54F = Military

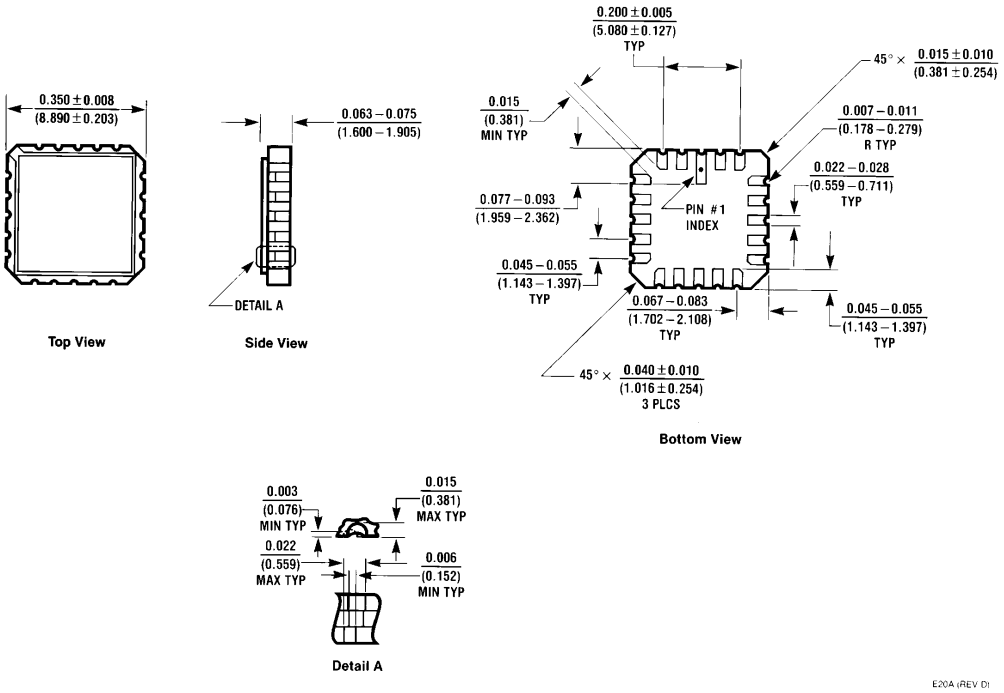
Device Type

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

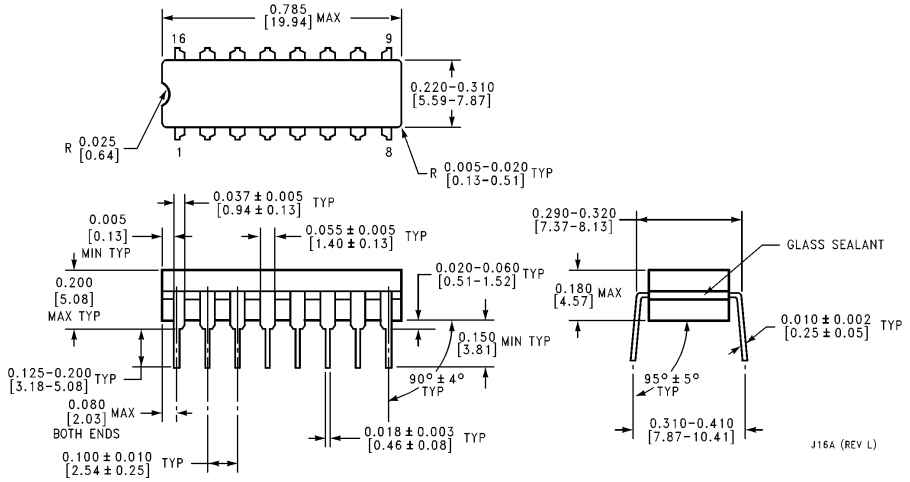
Temperature Range
C = Commercial (0°C to +70°C)
M = Military (−55°C to +125°C)

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

Physical Dimensions inches (millimeters)

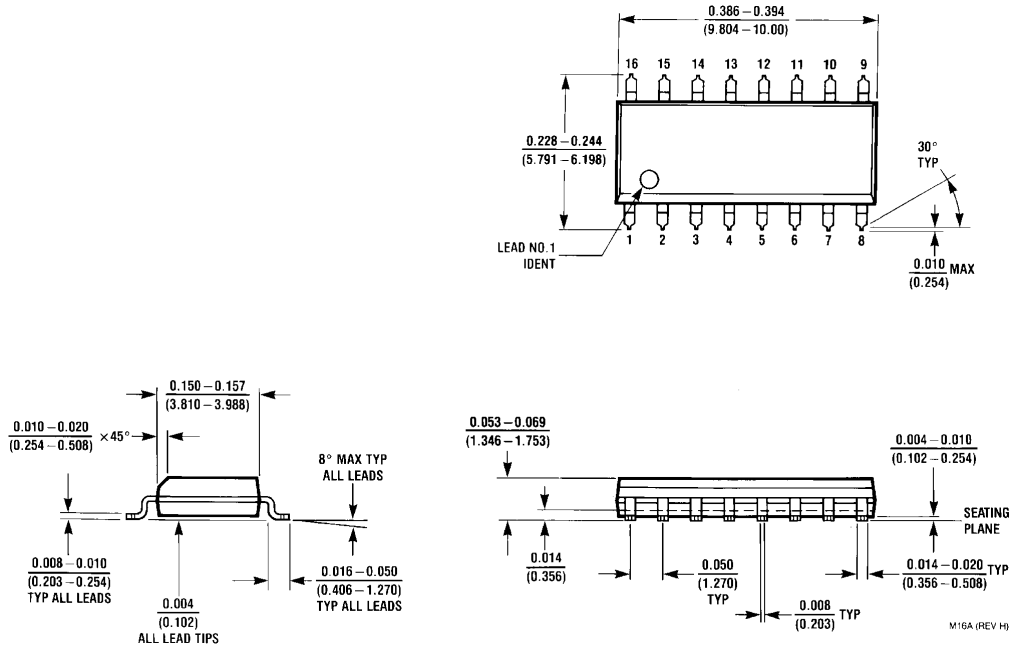


20-Lead Ceramic Leadless Chip Carrier (L)
NS Package Number E20A



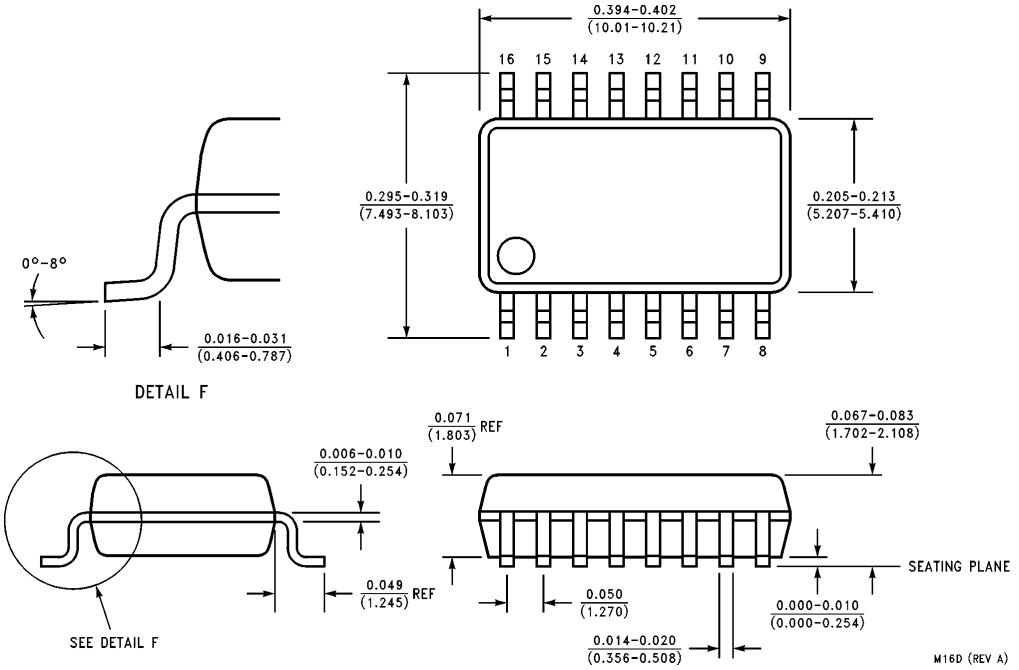
16-Lead Ceramic Dual In-Line Package (D)
NS Package Number J16A

Physical Dimensions inches (millimeters) (Continued)

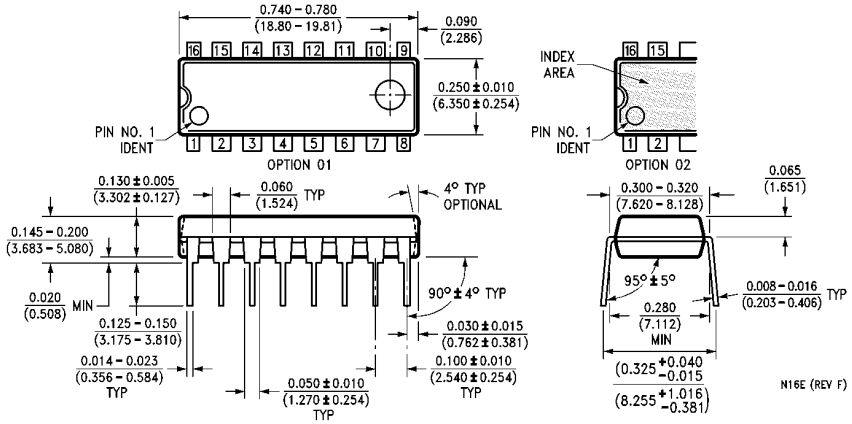


16-Lead (0.150″ Wide) Molded Small Outline Package, JEDEC (S)
NS Package Number M16A

Physical Dimensions inches (millimeters) (Continued)

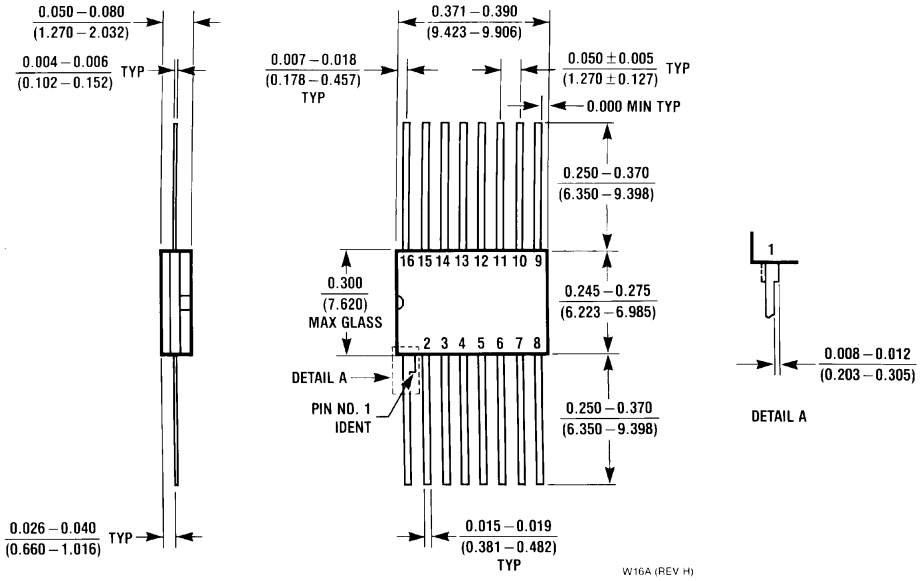


16-Lead (0.300″ Wide) Molded Small Outline Package, EIAJ (SJ)
NS Package Number M16D



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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