National Semiconductor

November 1994

54F/74F257A
Quad 2-Input Multiplexer with TRI-STATE® Outputs

General Description

The 'F257A is a quad 2-input multiplexer with TRI-STATE outputs. Four bits of data from two sources can be selected using a Common Data Select input. The four outputs present the selected data in true (non-inverted) form. The outputs may be switched to a high impedance state with a HIGH on the common Output Enable ($\overline{OE}$) input, allowing the outputs to interface directly with bus-oriented systems.

Features

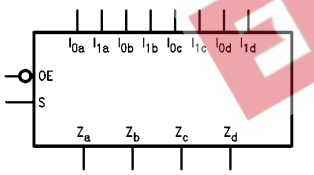
- Multiplexer expansion by tying outputs together
- Non-inverting TRI-STATE outputs
- Input clamp diodes limit high-speed termination effects
- Guaranteed 4000V minimum ESD protection

Commercial	Military	Package Number	Package Description
74F257APC		N16E	16-Lead (0.300″ Wide) Molded Dual-In-Line
	54F257ADM (Note 2)	J16A	16-Lead Ceramic Dual-In-Line
74F257ASC (Note 1)		M16A	16-Lead (0.150″ Wide) Molded Small Outline, JEDEC
74F257ASJ (Note 1)		M16D	16-Lead (0.300″ Wide) Molded Small Outline, EIAJ
	54F257AFM (Note 2)	W16A	16-Lead Cerpack
	54F257ALL (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



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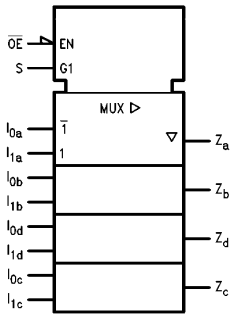
IEEE/IEC



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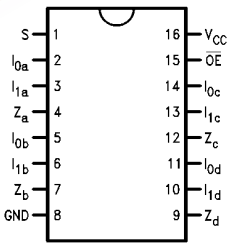
Connection Diagrams

Pin Assignment for DIP, SOIC and Flatpak



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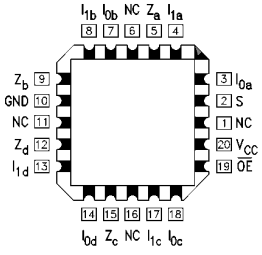
Pin Assignment for LCC



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RRD-B30M75/Printed in U. S. A.

Unit Loading/Fan Out

Pin Names	Description	54F/74F	
		U.L. HIGH/LOW	Input I_{IH}/I_{IL} Output I_{OH}/I_{OL}
S	Common Data Select Input	1.0/1.0	20 μA/−0.6 mA
$\overline{OE}$	TRI-STATE Output Enable Input (Active LOW)	1.0/1.0	20 μA/−0.6 mA
I_{0a}–I_{0d}	Data Inputs from Source 0	1.0/1.0	20 μA/−0.6 mA
I_{1a}–I_{1d}	Data Inputs from Source 1	1.0/1.0	20 μA/−0.6 mA
Z_a–Z_d	TRI-STATE Multiplexer Outputs	150/40 (33.3)	−3 mA/24 mA (20 mA)

Functional Description

The 'F257A is a quad 2-input multiplexer with TRI-STATE outputs. It selects four bits of data from two sources under control of a Common Data Select input. When the Select input is LOW, the I_{0x} inputs are selected and when Select is HIGH, the I_{1x} inputs are selected. The data on the selected inputs appears at the outputs in true (non-inverted) form. The device is the logic implementation of a 4-pole, 2-position switch where the position of the switch is determined by the logic levels supplied to the Select input. The logic equation for the outputs is shown below:

$$Z_n = \overline{OE} \bullet (I_n \bullet S + I_{on} \bullet \overline{S})$$

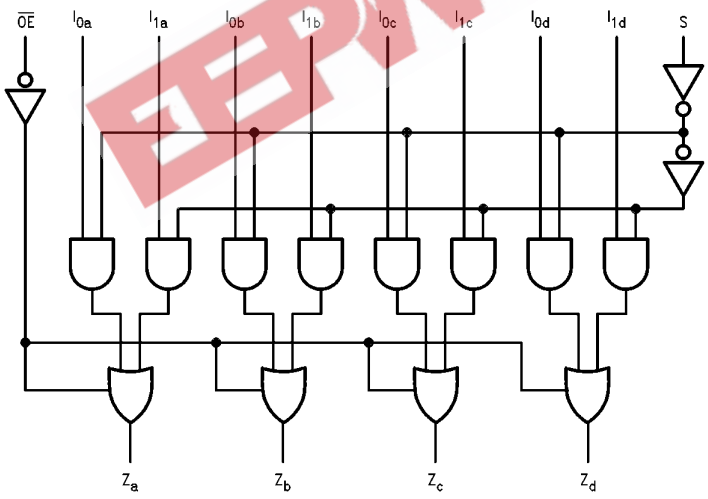
When the Output Enable input ($\overline{OE}$) is HIGH, the outputs are forced to a high impedance OFF state. If the outputs are tied together, all but one device must be in the high impedance state to avoid high currents that would exceed the maximum ratings. Designers should ensure the Output Enable signals to TRI-STATE devices whose outputs are tied together are designed so there is no overlap.

Truth Table

Output Enable	Select Input	Data Inputs		Output
$\overline{OE}$	S	I_0	I_1	Z
H	X	X	X	Z
L	H	X	L	L
L	H	X	H	H
L	L	L	X	L
L	L	H	X	H

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
Z = High Impedance

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)
ESD Last Passing Voltage (Min)	4000V

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
		54F 10% V_{CC}	2.4					I_{OH} = −3 mA
		74F 10% V_{CC}	2.5					I_{OH} = −1 mA
		74F 10% V_{CC}	2.4					I_{OH} = −3 mA
		74F 5% V_{CC}	2.7					I_{OH} = −1 mA
		74F 5% V_{CC}	2.7					I_{OH} = −3 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} = 24 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_{OZH}	Output Leakage Current				50	μA	Max	V_{OUT} = 2.7V
I_{OZL}	Output Leakage Current				−50	μA	Max	V_{OUT} = 0.5V
I_{OS}	Output Short-Circuit Current		−60		−150	mA	Max	V_{OUT} = 0V
I_{ZZ}	Bus Drainage Test				500	μA	0.0V	V_{OUT} = 5.25V
I_{CCH}	Power Supply Current			9.0	15	mA	Max	V_O = HIGH
I_{CCL}	Power Supply Current			14.5	22	mA	Max	V_O = LOW
I_{CCZ}	Power Supply Current			15	23	mA	Max	V_O = HIGH Z

AC Electrical Characteristics

Symbol	Parameter	74F			54F		74F		Units
		$T_A = +25°C$ $V_{CC} = +5.0V$ $C_L = 50$ 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	
t_{PLH} t_{PHL}	Propagation Delay I_n to Z_n	2.5 2.0	4.5 4.2	5.5 5.5	2.0 1.5	7.0 7.0	2.0 2.0	6.0 6.0	ns
t_{PLH} t_{PHL}	Propagation Delay S to Z_n	4.0 2.5	5.0 6.5	9.5 7.0	3.5 2.5	11.5 9.0	3.5 2.5	10.5 8.0	ns
t_{PZH} t_{PZL}	Output Enable Time	2.0 2.5	5.9 5.5	6.0 7.0	2.0 2.5	8.0 9.0	2.0 2.5	7.0 8.0	ns
t_{PHZ} t_{PLZ}	Output Disable Time	2.0 2.0	4.3 4.5	6.0 6.0	2.0 2.0	7.0 8.5	2.0 2.0	7.0 7.0	

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 257A S C X

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

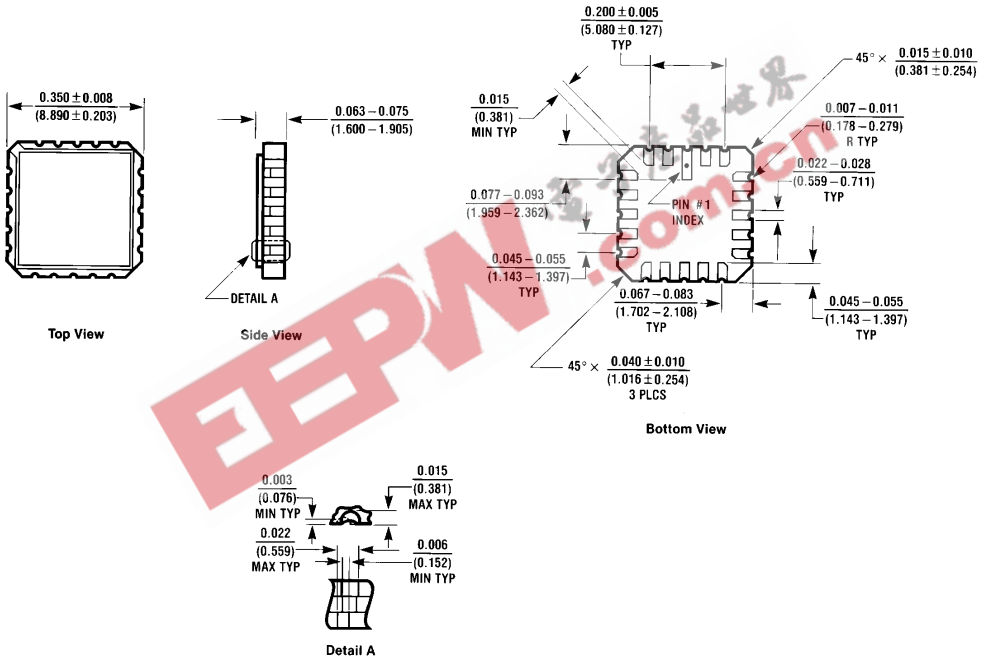
Device Type

Package Code
- P = Plastic DIP
- D = Ceramic DIP
- F = Flatpak
- L = Leadless Ceramic 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)

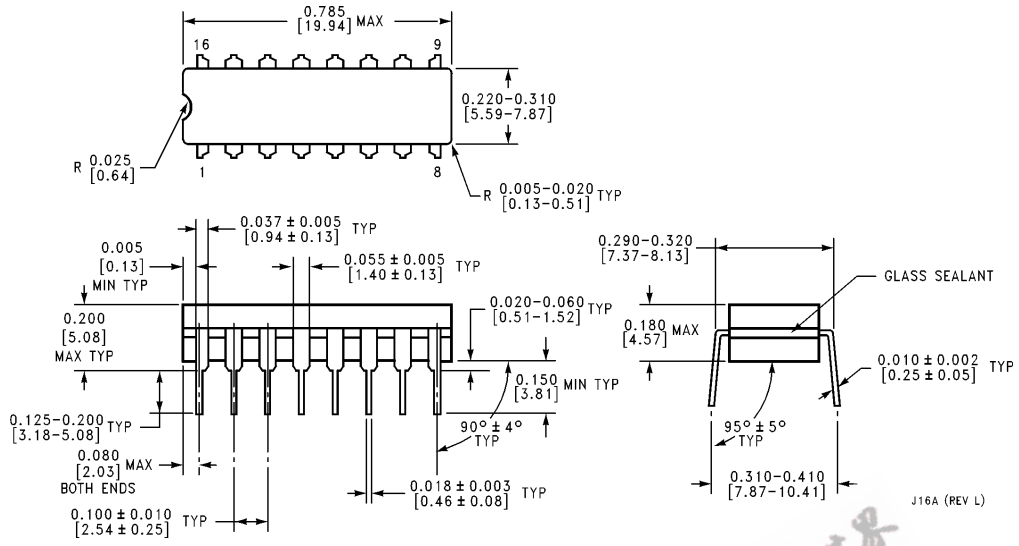
Special Variations
- X = Devices shipped in 13″ reels
- QB = Military grade with environmental and burn-in processing shipped in tubes

Physical Dimensions inches (millimeters)

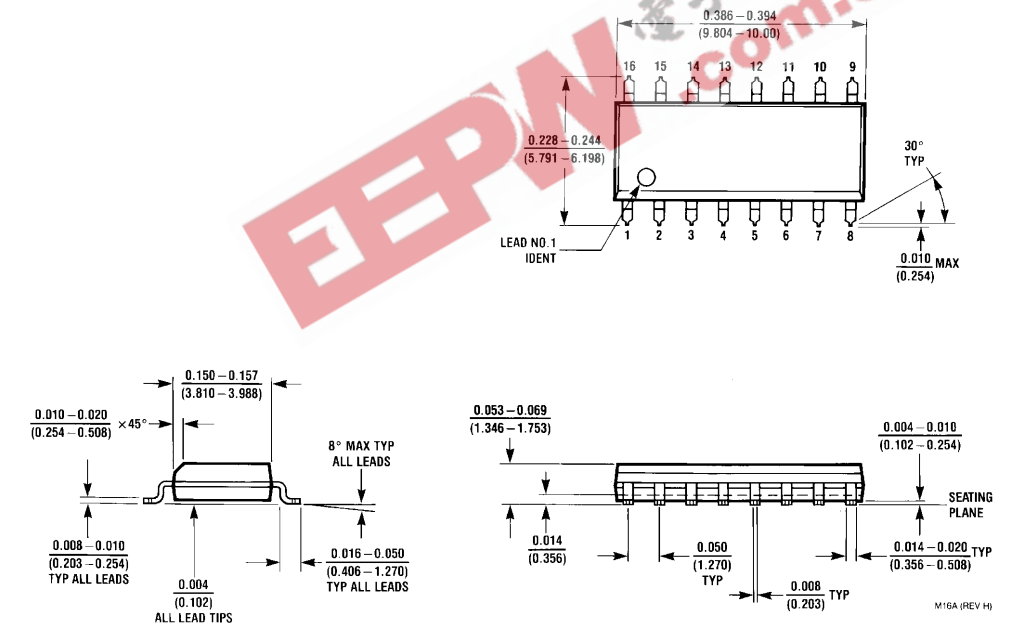


20-Lead Ceramic Leadless Chip Carrier (L)
NS Package Number E20A

Physical Dimensions inches (millimeters) (Continued)

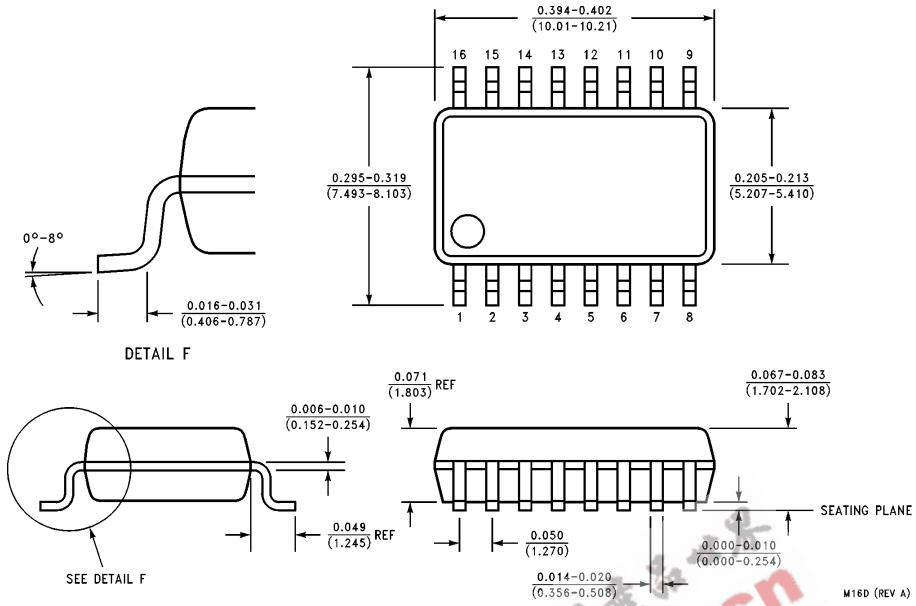


16-Lead Ceramic Dual-In-Line Package (D)
NS Package Number J16A

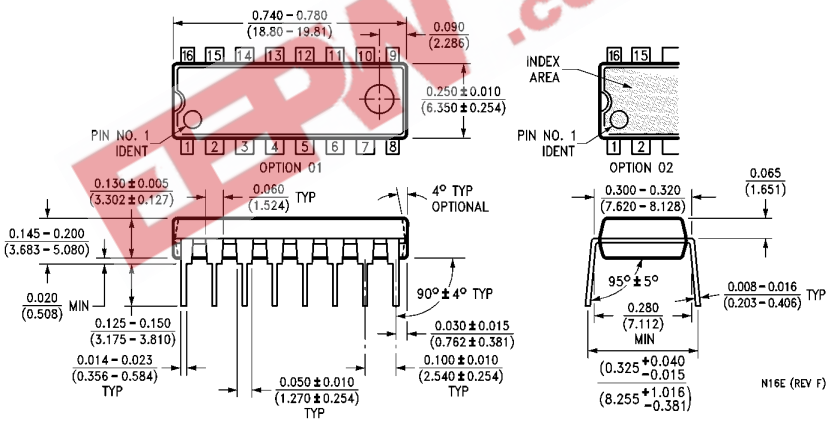


16-Lead (0.150″ Wide) Molded Small Outline Package, JEDEC (S)
NS Package Number M16A

Physical Dimensions inches (millimeters) (Continued)

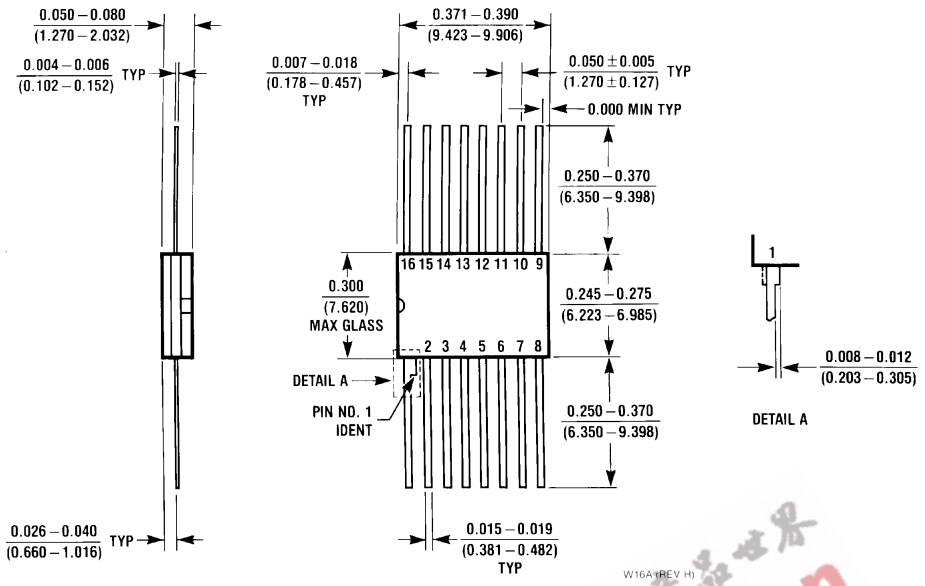


16-Lead (0.300″ Wide) Molded Small Outline Package, EIAJ (SJ)
NS Package Number M16D



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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