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April 1988
Revised September 2000

74F350 4-Bit Shifter with 3-STATE Outputs

General Description

The 74F350 is a specialized multiplexer that accepts a 4-bit word and shifts it 0, 1, 2 or 3 places, as determined by two Select (S_0, S_1) inputs. For expansion to longer words, three linking inputs are provided for lower-order bits; thus two linkages can shift an 8-bit word, four packages a 16-bit word, etc. Shifting by more than three places is accomplished by paralleling the 3-STATE outputs of different packages and using the Output Enable (\overline{OE}) inputs as a third Select level. With appropriate interconnections, the 74F350 can perform zero-backfill, sign-extend or end-around (barrel) shift functions.

Features

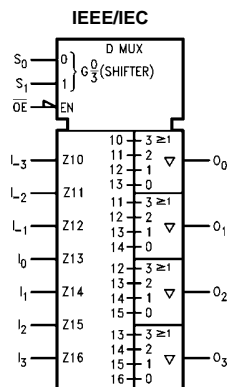
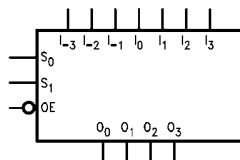
- Linking inputs for word expansion
- 3-STATE outputs for extending shift range

Ordering Code:

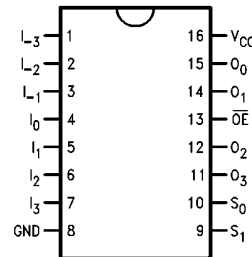
Order Number	Package Number	Package Description
74F350SC	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow
74F350SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74F350PC	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Logic Symbols



Connection Diagram



Truth Table

Inputs			Outputs			
\overline{OE}	S_1	S_0	O_0	O_1	O_2	O_3
H	X	X	Z	Z	Z	Z
L	L	L	I_0	I_1	I_2	I_3
L	L	H	I_{-1}	I_0	I_1	I_2
L	H	L	I_{-2}	I_{-1}	I_0	I_1
L	H	H	I_{-3}	I_{-2}	I_{-1}	I_0

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

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Unit Loading/Fan Out

Pin Names	Description	U.L. HIGH/LOW	Input I _H /I _L Output I _{OH} /I _{OL}
S ₀ , S ₁	Select Inputs	1.0/2.0	20 μA/-1.2 mA
I ₃ -I ₀	Data Inputs	1.0/2.0	20 μA/-1.2 mA
\overline{OE}	Output Enable Input (Active LOW)	1.0/2.0	20 μA/-1.2 mA
O ₀ -O ₃	3-STATE Outputs	150/40 (33.3)	-3 mA/24 mA (20 mA)

Functional Description

The 74F350 is operationally equivalent to a 4-input multiplexer with the inputs connected so that the select code causes successive one-bit shifts of the data word. This internal connection makes it possible to perform shifts of 0, 1, 2 or 3 places on words of any length.

A 4-bit data word is introduced at the I_n inputs and is shifted according to the code applied to the select inputs S₀, S₁. Outputs O₀-O₃ are 3-STATE, controlled by an active LOW output enable (\overline{OE}). When \overline{OE} is LOW, data outputs will follow selected data inputs; when HIGH, the data outputs will be forced to the high impedance state. This feature allows shifters to be cascaded on the same output lines or to a common bus. The shift function can be

logical, with zeros pulled in at either or both ends of the shifting field; arithmetic, where the sign bit is repeated during a shift down; or end around, where the data word forms a continuous loop.

Logic Equations

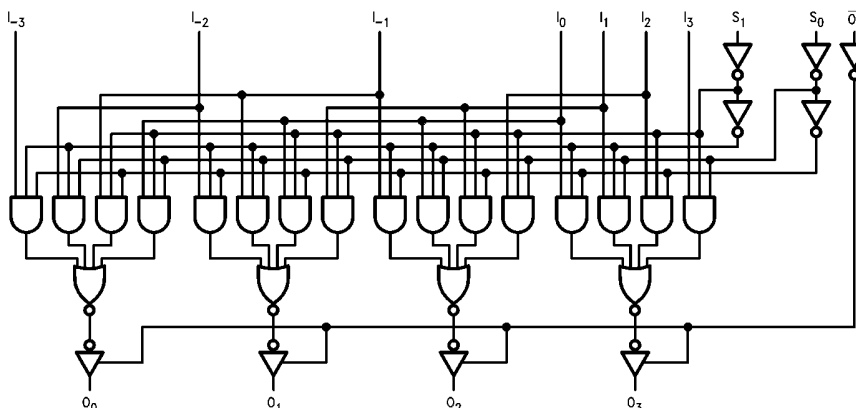
$$O_0 = \overline{S_0} \overline{S_1} I_0 + S_0 \overline{S_1} I_{-1} + \overline{S_0} S_1 I_{-2} + S_0 S_1 I_{-3}$$

$$O_1 = \overline{S_0} \overline{S_1} I_1 + S_0 \overline{S_1} I_0 + \overline{S_0} S_1 I_{-1} + S_0 S_1 I_{-2}$$

$$O_2 = \overline{S_0} \overline{S_1} I_2 + S_0 \overline{S_1} I_1 + \overline{S_0} S_1 I_0 + S_0 S_1 I_{-1}$$

$$O_3 = \overline{S_0} \overline{S_1} I_3 + S_0 \overline{S_1} I_2 + \overline{S_0} S_1 I_1 + S_0 S_1 I_0$$

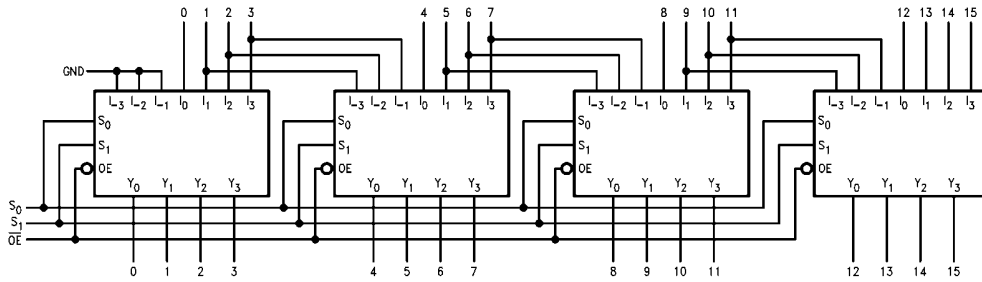
Logic Diagram



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

Applications

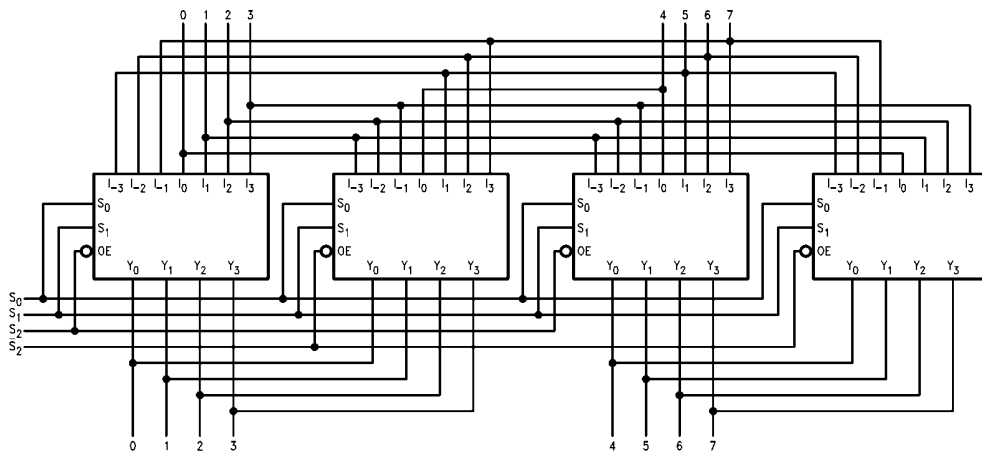
16-Bit Shift-Up 0 to 3 Places, Zero Backfill



Function Table

S ₁	S ₀	Shift Function
L	L	No Shift
L	H	Shift 1 Place
H	L	Shift 2 Places
H	H	Shift 3 Places

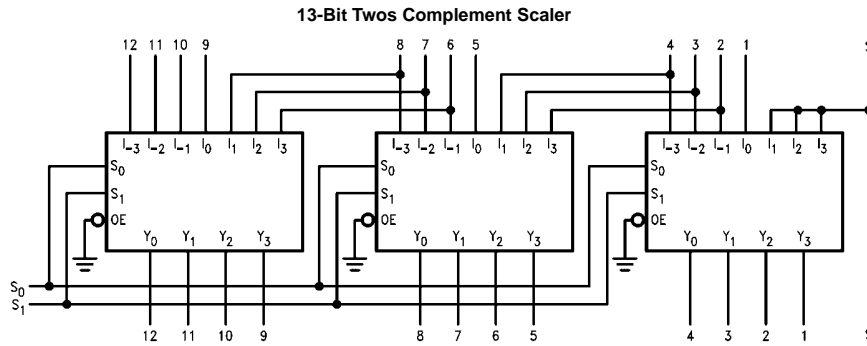
8-Bit End Around Shift 0 to 7 Places



Function Table

S ₂	S ₁	S ₀	Shift Function
L	L	L	No Shift
L	L	H	Shift End Around 1
L	H	L	Shift End Around 2
L	H	H	Shift End Around 3
H	L	L	Shift End Around 4
H	L	H	Shift End Around 5
H	H	L	Shift End Around 6
H	H	H	Shift End Around 7

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Function Table

S ₁	S ₀	Scale
L	L+8	1/8
L	H+4	1/4
H	L+2	1/2
H	H No Change	1

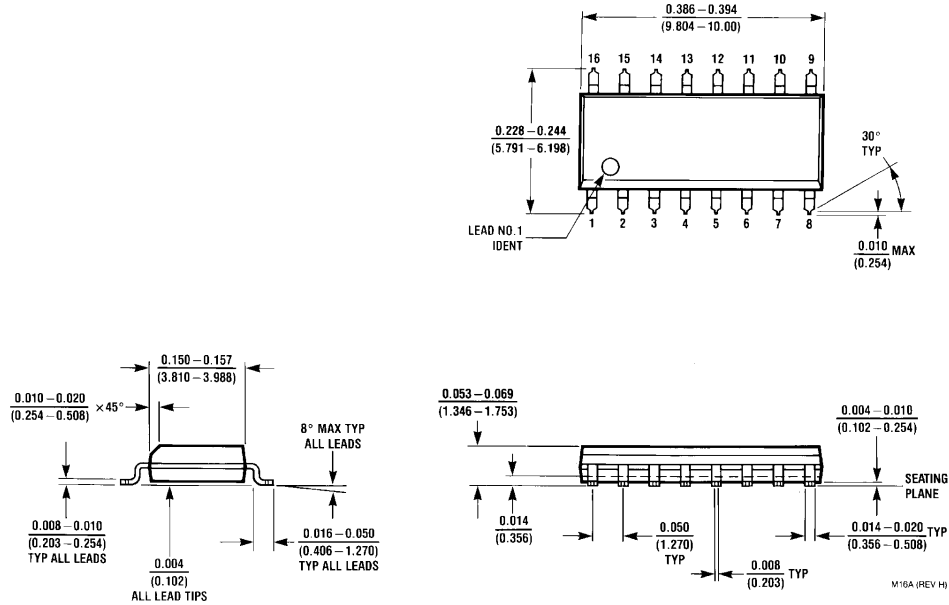
Symbol	Parameter	Min	Typ	Max	Units	V _{CC}	Conditions
V _{IH}	Input HIGH Voltage	2.0			V		Recognized as a HIGH Signal
V _{IL}	Input LOW Voltage			0.8	V		Recognized as a LOW Signal
V _{CD}	Input Clamp Diode Voltage			-1.2	V	Min	I _{IN} = -18 mA
V _{OH}	Output HIGH Voltage	10% V _{CC}	2.5		V	Min	I _{OH} = -1 mA
		10% V _{CC}	2.4	I _{OH} = -3 mA			
		5% V _{CC}	2.7	I _{OH} = -1 mA			
		10% V _{CC}	2.7	I _{OH} = -3 mA			
V _{OL}	Output LOW Voltage	10% V _{CC}		0.5	V	Min	I _{OL} = 24 mA
I _{IH}	Input HIGH Current			5.0	μA	Max	V _{IN} = 2.7V
I _{BVI}	Input HIGH Current Breakdown Test			7.0	μA	Max	V _{IN} = 7.0V
I _{CEX}	Output HIGH Leakage Current			50	μA	Max	V _{OUT} = V _{CC}
V _{ID}	Input Leakage Test	4.75			V	0.0	I _{ID} = 1.9 μA All Other Pins Grounded
I _{OD}	Output Leakage Circuit Current			3.75	μA	0.0	V _{IOD} = 150 mV All Other Pins Grounded
I _{IL}	Input LOW Current			-1.2	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		34	42	mA	Max	V _O = HIGH
I _{CCL}	Power Supply Current		40	57	mA	Max	V _O = LOW
I _{CCZ}	Power Supply Current		40	57	mA	Max	V _O = HIGH Z

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AC Electrical Characteristics

Symbol	Parameter	T _A = +25°C V _{CC} = +5.0V C _L = 50 pF			T _A = 0°C to +70°C V _{CC} = +5.0V C _L = 50 pF		Units
		Min	Typ	Max	Min	Max	
t _{PLH}	Propagation Delay	3.0	4.5	6.0	3.0	7.0	ns
t _{PHL}	I _n to O _n	2.5	4.0	5.5	2.5	6.5	
t _{PLH}	Propagation Delay	4.0	7.8	10.0	4.0	13.5	ns
t _{PHL}	S _n to O _n	3.0	6.5	8.5	3.0	9.5	
t _{PZH}	Output Enable Time	2.5	5.0	7.0	2.5	8.0	ns
t _{PZL}		4.0	7.0	9.0	4.0	10.0	
t _{PHZ}	Output Disable Time	2.0	3.9	5.5	2.0	6.5	
t _{PLZ}		2.0	4.0	5.5	2.0	7.5	

Physical Dimensions inches (millimeters) unless otherwise noted

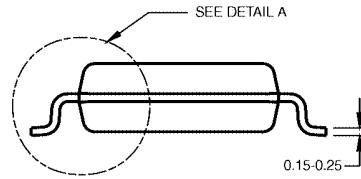
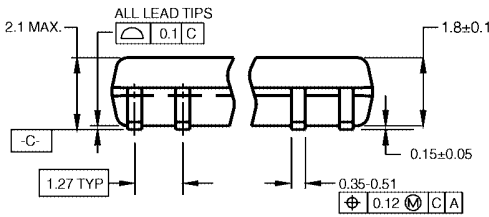
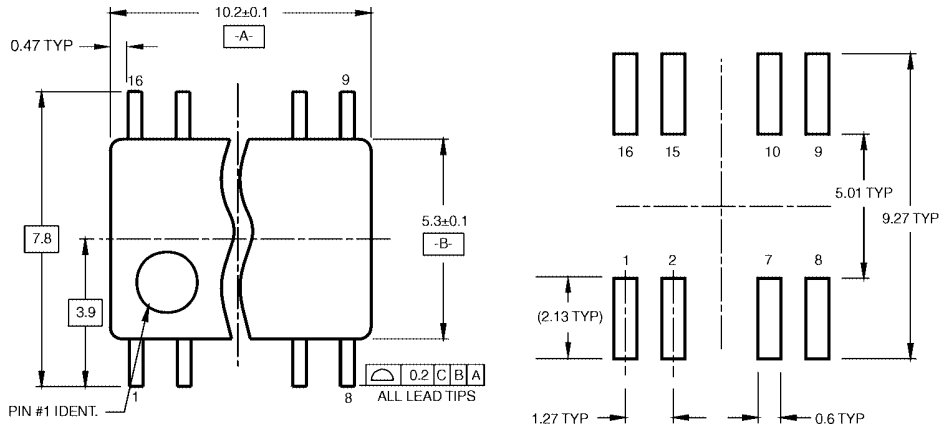


16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow Package Number M16A

M16A (REV H)

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

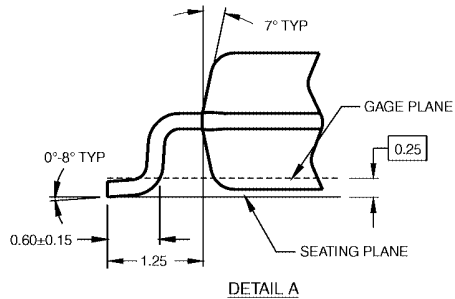


DIMENSIONS ARE IN MILLIMETERS

NOTES:

- A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M16DRevB1



**16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
Package Number M16D**

