

## 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 packages 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

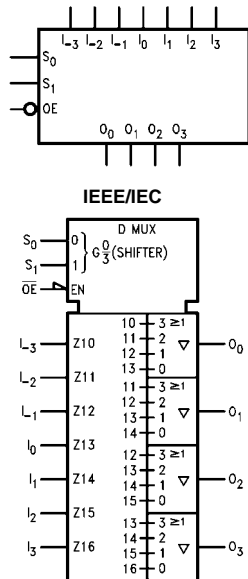
- Linking inputs for word expansion
- 3-STATE outputs for extending shift range

### Ordering Code:

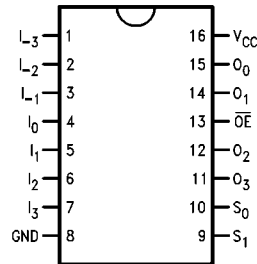
Order Number	Package Number	Package Description
74F350SC	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow
74F350SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74F350PC	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide

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

## Unit Loading/Fan Out

Pin Names	Description	U.L. HIGH/LOW	Input $I_{IH}/I_{IL}$ Output $I_{OH}/I_{OL}$
$S_0, S_1$	Select Inputs	1.0/2.0	20 $\mu$ A/-1.2 mA
$I_3-I_0$	Data Inputs	1.0/2.0	20 $\mu$ A/-1.2 mA
$\overline{OE}$	Output Enable Input (Active LOW)	1.0/2.0	20 $\mu$ A/-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  $S_0, S_1$ . Outputs  $O_0-O_3$  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

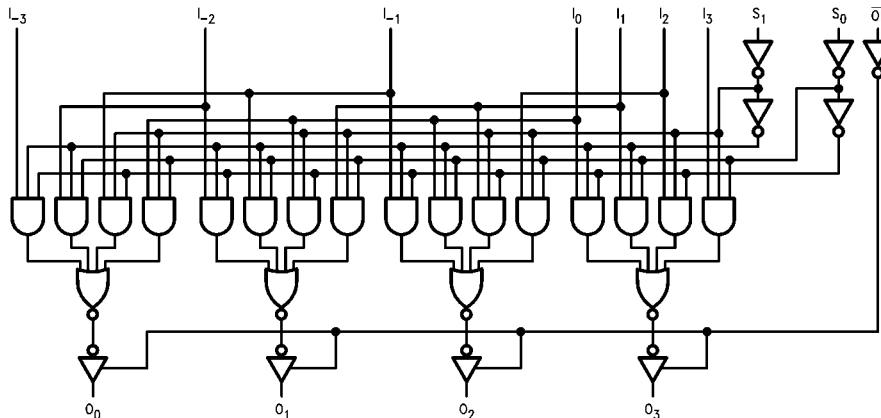
$$O_0 = \overline{S_0}\overline{S_1}I_0 + S_0\overline{S_1}I_1 + \overline{S_0}S_1I_2 + S_0S_1I_3$$

$$O_1 = \overline{S_0}\overline{S_1}I_1 + S_0\overline{S_1}I_0 + \overline{S_0}S_1I_1 + S_0S_1I_2$$

$$O_2 = \overline{S_0}\overline{S_1}I_2 + S_0\overline{S_1}I_1 + \overline{S_0}S_1I_0 + S_0S_1I_1$$

$$O_3 = \overline{S_0}\overline{S_1}I_3 + S_0\overline{S_1}I_2 + \overline{S_0}S_1I_1 + S_0S_1I_0$$

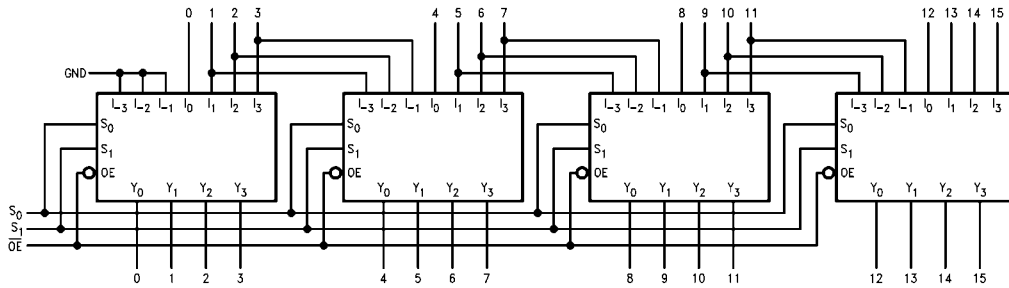
## Logic Diagram



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

**Applications**

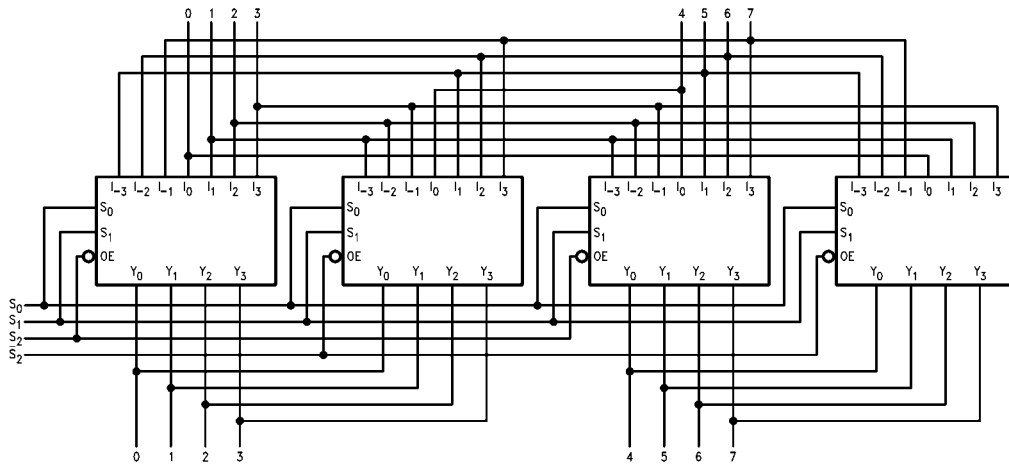
**16-Bit Shift-Up 0 to 3 Places, Zero Backfill**



**Function Table**

S <sub>1</sub>	S <sub>0</sub>	Shift Function
L	L	No Shift
L	H	Shift 1 Place
H	L	Shift 2 Places
H	H	Shift 3 Places

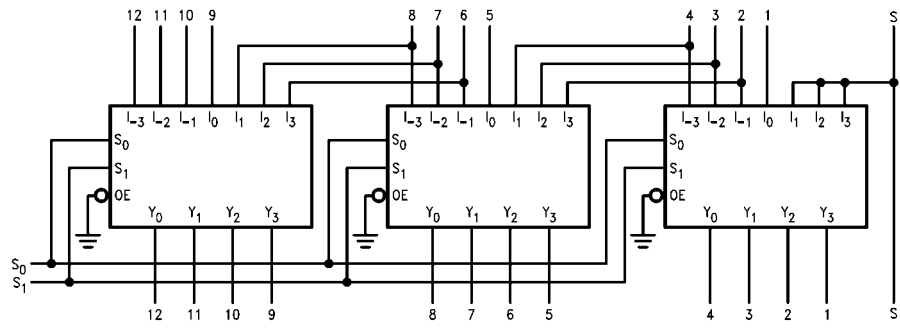
**8-Bit End Around Shift 0 to 7 Places**



**Function Table**

S <sub>2</sub>	S <sub>1</sub>	S <sub>0</sub>	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

13-Bit Two's Complement Scaler



Function Table

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

**Absolute Maximum Ratings**(Note 1)

Storage Temperature	-65°C to +150°C
Ambient Temperature under Bias	-55°C to +125°C
Junction Temperature under Bias	-55°C to +150°C
V <sub>CC</sub> 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<sub>CC</sub> = 0V)

Standard Output -0.5V to V<sub>CC</sub>

3-STATE Output -0.5V to +5.5V

Current Applied to Output

in LOW State (Max) twice the rated I<sub>OL</sub> (mA)

**Recommended Operating Conditions**

Free Air Ambient Temperature	0°C to +70°C
Supply Voltage	+4.5V to +5.5V

**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.

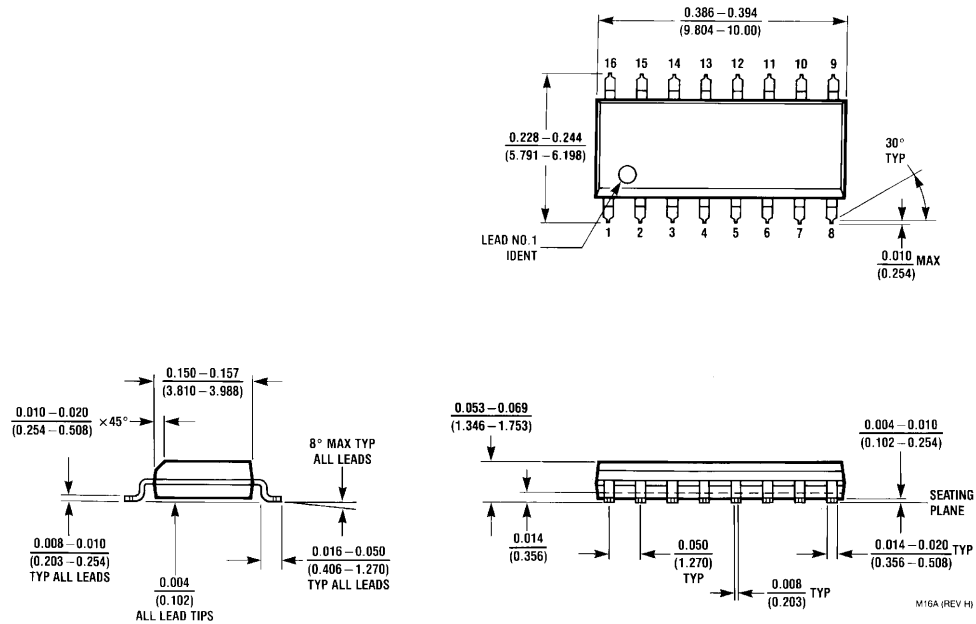
**DC Electrical Characteristics**

Symbol	Parameter	Min	Typ	Max	Units	V <sub>CC</sub>	Conditions
V <sub>IH</sub>	Input HIGH Voltage	2.0			V		Recognized as a HIGH Signal
V <sub>IL</sub>	Input LOW Voltage			0.8	V		Recognized as a LOW Signal
V <sub>CD</sub>	Input Clamp Diode Voltage			-1.2	V	Min	I <sub>IN</sub> = -18 mA
V <sub>OH</sub>	Output HIGH Voltage	10% V <sub>CC</sub> 10% V <sub>CC</sub> 5% V <sub>CC</sub> 10% V <sub>CC</sub>	2.5 2.4 2.7 2.7		V	Min	I <sub>OH</sub> = -1 mA I <sub>OH</sub> = -3 mA I <sub>OH</sub> = -1 mA I <sub>OH</sub> = -3 mA
V <sub>OL</sub>	Output LOW Voltage	10% V <sub>CC</sub>		0.5	V	Min	I <sub>OL</sub> = 24 mA
I <sub>IH</sub>	Input HIGH Current			5.0	μA	Max	V <sub>IN</sub> = 2.7V
I <sub>BVI</sub>	Input HIGH Current Breakdown Test			7.0	μA	Max	V <sub>IN</sub> = 7.0V
I <sub>CEx</sub>	Output HIGH Leakage Current			50	μA	Max	V <sub>OUT</sub> = V <sub>CC</sub>
V <sub>ID</sub>	Input Leakage Test	4.75			V	0.0	I <sub>ID</sub> = 1.9 μA All Other Pins Grounded
I <sub>OD</sub>	Output Leakage Circuit Current			3.75	μA	0.0	V <sub>IOD</sub> = 150 mV All Other Pins Grounded
I <sub>IL</sub>	Input LOW Current			-1.2	mA	Max	V <sub>IN</sub> = 0.5V
I <sub>OZH</sub>	Output Leakage Current			50	μA	Max	V <sub>OUT</sub> = 2.7V
I <sub>OZL</sub>	Output Leakage Current			-50	μA	Max	V <sub>OUT</sub> = 0.5V
I <sub>OS</sub>	Output Short-Circuit Current	-60		-150	mA	Max	V <sub>OUT</sub> = 0V
I <sub>ZZ</sub>	Bus Drainage Test			500	μA	0.0V	V <sub>OUT</sub> = 5.25V
I <sub>CCH</sub>	Power Supply Current		34	42	mA	Max	V <sub>O</sub> = HIGH
I <sub>CCL</sub>	Power Supply Current		40	57	mA	Max	V <sub>O</sub> = LOW
I <sub>CCZ</sub>	Power Supply Current		40	57	mA	Max	V <sub>O</sub> = HIGH Z

## AC Electrical Characteristics

Symbol	Parameter	T <sub>A</sub> = +25°C			T <sub>A</sub> = 0°C to +70°C		Units
		V <sub>CC</sub> = +5.0V			V <sub>CC</sub> = +5.0V		
		C <sub>L</sub> = 50 pF			C <sub>L</sub> = 50 pF		
		Min	Typ	Max	Min	Max	
t <sub>PLH</sub>	Propagation Delay	3.0	4.5	6.0	3.0	7.0	ns
t <sub>PHL</sub>	I <sub>n</sub> to O <sub>n</sub>	2.5	4.0	5.5	2.5	6.5	
t <sub>PLH</sub>	Propagation Delay	4.0	7.8	10.0	4.0	13.5	ns
t <sub>PHL</sub>	S <sub>n</sub> to O <sub>n</sub>	3.0	6.5	8.5	3.0	9.5	
t <sub>PZH</sub>	Output Enable Time	2.5	5.0	7.0	2.5	8.0	ns
t <sub>PZL</sub>		4.0	7.0	9.0	4.0	10.0	
t <sub>PHZ</sub>	Output Disable Time	2.0	3.9	5.5	2.0	6.5	
t <sub>PLZ</sub>		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**

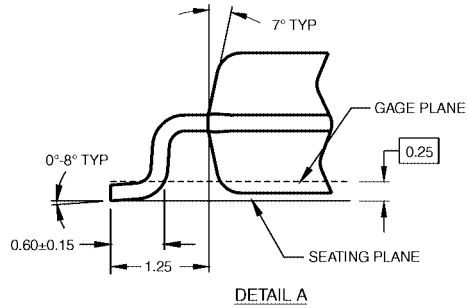
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



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.

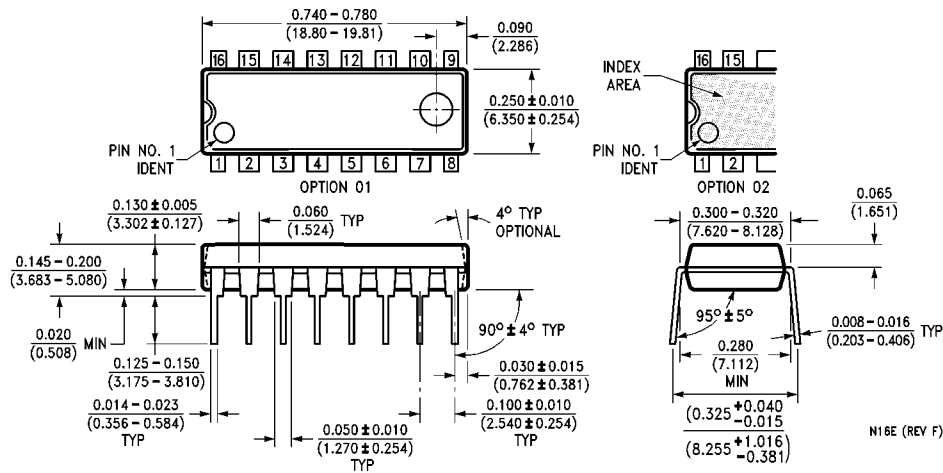
M16DRRevB1



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



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



**16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide Package Number N16E**

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